

WATER POLLUTION CONTROL LEGISLATION
OCEAN DUMPING
Part 5

HEARINGS
BEFORE THE
SUBCOMMITTEE ON
AIR AND WATER POLLUTION
OF THE
COMMITTEE ON PUBLIC WORKS
UNITED STATES SENATE
NINETY-SECOND CONGRESS

FIRST SESSION
ON
S. 75, S. 192, S. 280, S. 281, S. 523, S. 573, S. 601, S. 679, S. 927,
S. 1011, S. 1012, S. 1013, S. 1014, S. 1015, and S. 1017
BILLS AMENDING THE FEDERAL WATER POLLUTION CONTROL
ACT AND OTHER PENDING LEGISLATION RELATING
TO WATER POLLUTION CONTROL

MARCH 26, 1971
REHOBOTH BEACH, DEL.
JUNE 16, 1971
WASHINGTON, D.C.

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WATER POLLUTION CONTROL LEGISLATION

Ocean Dumping

FRIDAY, MARCH 26, 1971

**U.S. SENATE,
SUBCOMMITTEE ON AIR AND WATER POLLUTION
OF THE COMMITTEE ON PUBLIC WORKS,
*Rehoboth Beach, Del.***

The subcommittee met, pursuant to call, at 9 a.m., at the Convention Hall, Rehoboth Beach, Del., Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Muskie, Boggs, Beall, and Buckley.

Also present: Leon G. Billings, Richard D. Grundy, Richard W. Wilson, and Walter Westman, professional staff members, and Bailey Guard, minority chief clerk, Thomas C. Jorling, minority counsel, and Harold G. Brayman, minority staff.

OPENING STATEMENT OF HON. EDMUND S. MUSKIE, CHAIRMAN OF THE SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE SENATE PUBLIC WORKS COMMITTEE

Senator MUSKIE. The committee will be in order.

First, I would like to say how pleased we all are to be here in Rehoboth this morning. We are conducting a hearing on a subject of great interest to the people of this area, indeed, of four or five States in this area. The subject is of concern to me as a Senator from a coastal State as well. I am delighted that so many of my colleagues in the Senate found it possible to attend, and I apologize for the fact that I have to leave about noon to get back to Washington. We will read the testimony that we don't hear directly today and look forward to pressing the legislation which can make a beginning in dealing with the problem.

On that point I would like to make this brief opening statement.

The subcommittee is meeting today in Rehoboth Beach because the control of ocean pollution and ocean dumping is a primary concern of the subcommittee during this session of the Congress. Indeed, it is a continuing concern of the subcommittee. During the past 3 years we have considered and reported legislation in this field, particularly in the prevention and cleanup of oil spills.

Today, the subcommittee is especially interested in the problems of ocean dumping off the coasts of Delaware, Maryland and New Jersey. We have received reports of plans to discharge millions of gallons a day of wastes into the Atlantic beyond the Continental Shelf, and we know that 140 million tons of sewage are already being dumped off the coast of Rehoboth Beach.

I understand this dumping reduces pollution in the rivers of Delaware, Maryland and New Jersey. But it does so at the expense of the Atlantic Ocean, the fishermen who make their living off this coast and all residents of Delaware, Maryland and New Jersey who live downstream.

This alone is unacceptable. From 8 years of legislative work in pollution control, this subcommittee has learned that no citizen likes the idea of living with wastes dumped by those who live upstream.

In a broader, ecological sense, this subcommittee certainly has learned that everyone does live downstream from someone else, and if the oceans are contaminated for any of us, the oceans are contaminated for all of us.

If I may state my position at the outset of today's hearing, it is simply this: no ocean disposal of wastes from the mid-Atlantic States is acceptable unless there is adequate proof that there will be no further degradation of the ocean depths and coastal waters. There must be no adverse effect upon the marine life or the recreation resources of our invaluable ocean beaches.

With that brief statement of our concern and our determination to deal with this problem effectively, I would like to turn the microphone over to my colleague, the ranking Republican of the Subcommittee on Air and Water Pollution. It has been my privilege to work with him in this field for a number of years, and I never think of him as a Republican, and I understand that many of his constituents don't either. [Laughter.]

Senator CASE. You think of yourself as a Democrat, though. [Laughter.]

Senator MUSKIE. Senator Boggs has been of invaluable assistance—and I say this without any qualification whatsoever—in this work of putting together public policies, legislation, and programs, to deal effectively with this problem of pollution. It is a real pleasure to be here at his invitation to participate in this hearing in his State. I suppose I should have asked him to welcome us first, but I was so sure of the welcome that I didn't do so.

Cale, I am sure you have a few words you would like to say.

OPENING REMARKS OF HON. CALEB BOGGS OF DELAWARE, RANKING MINORITY MEMBER OF THE SUBCOMMITTEE ON AIR AND WATER POLLUTION

Senator Boggs. Thank you, Mr. Chairman. You are very kind to make those remarks. It has been a great privilege to work with you and the other members of this committee, as well as the Members of the Senate, in a nonpartisan manner on these very important environmental issues.

I do want to join my colleague, Senator Roth, and all Delawareans in welcoming you, Senator Beall, Senator Buckley, Senator Case, Congressman Sandman, Chairman Train, as well as the other distinguished witnesses who have come to Delaware for today's hearing. You must be impressed, as I am, by the tremendous turnout for this morning's hearing. An audience of this size demonstrates very clearly that a real interest and concern exists over the question of ocean disposal of pollutants.

Rehoboth Beach, as you know, is properly called the Nation's "Summer Capital" with this turnout today, it looks like the Nation's "Spring Capital" as well. You have visited Delaware many times, and I am hopeful you will have many more occasions to visit our great State. I remember well the honor I had to visit Maine last fall for another hearing by our subcommittee on air and water pollution. That was a very informative and enjoyable visit.

Mr. Chairman, you have stated our purpose very well. I want to join you and the other members of the committee in expressing our appreciation to the Mayor and to all of his associates for arranging for the use of this excellent facility, and for making the arrangements to enable the hearing to move along expeditiously. We have a full and informative hearing scheduled today; I hope it will be possible to complete testimony from all the witnesses.

Both Senators Beall and Buckley are new to our subcommittee this year. But in the few short weeks since they assumed that membership, each has added strength to the workings of our subcommittee. They bring to the subcommittee's activities great dedication and knowledge in the effort to achieve environmental enhancement.

I wish time would permit each of you to remain in Delaware a bit longer. All Delawareans, I know, want to extend our thanks to you for taking the time to travel here. Your presence demonstrates clearly that we share a recognition of the challenge created by the use of our oceans for waste disposal, a challenge that affects not only the area beyond the mouth of Delaware Bay, but the entire Nation.

I know that the citizens of Rehoboth Beach are also honored to have two Senators, including my colleague, Senator Roth, and a Member of the House with us today, to testify on ocean dumping legislation. The subcommittee will be most attentive to the testimony of Senators Case and Roth and Congressman Sandman. Your advice and counsel will be most valuable to our subcommittee as we consider this legislation in the days ahead.

It is also a great honor to welcome to our State the chairman of the President's Council on Environmental Quality, Russell Train.

The Council's important study of ocean dumping practices, which was issued last fall, must be the definitive study in the field. This study pointed out the dramatic growth in the volume of ocean dumping in recent years, and it identified more than 250 disposal sites along our coasts.

Just in recent weeks we have seen incidents in which industry planned to dump highly toxic chemicals into the oceans. Legal action, fortunately, was effective in holding up the planned disposal of a large quantity of arsenic.

But dumping of materials such as sulfuric acid, mercury, cyanide, pesticides, sewage sludge, and cannery wastes continues. There is no doubt that these waste disposal practices pose a threat to the oceans of our planet.

Such potential environmental dangers demonstrate clearly that 1971 must be the year when we establish a clear national policy over ocean disposal practices. Some form of a permit system would appear to be essential.

Today's hearing, I am hopeful, will give this committee the information we need to legislate wisely and to prevent the continued use of our seas as sewers. This does not mean that all dumping must necessarily

be ended. But it does mean that the Federal Government, I believe, must be equipped with the means to prevent ocean disposal of those materials that are particularly hazardous, and encourage alternative disposal methods for other pollutants.

I know I am speaking for the entire subcommittee when I express our thanks for the time and effort taken by each of the witnesses in attending this hearing.

I would like to pay particular tribute to the many officials from the New Jersey-Delaware-Maryland area who are with us today. The Stop Ocean Dumping Association is to be commended most highly for its great efforts in focusing public attention on offshore dumping practices.

The many witnesses scheduled today actually represent a small fraction among those who have expressed an interest in testifying. Many of those who are not on the witness list can add valuable information to our hearing. I am hopeful that we will have the opportunity after we hear from the scheduled witnesses to hear before 4:30 or 5 p.m. from many other persons who are here. Otherwise we will certainly make their views a part of the hearing record so these views can be evaluated carefully by the entire Senate.

In closing, I would like to offer particular thanks on behalf of the subcommittee to Mayor Lester Johnson and to the city of Rehoboth Beach for their warm hospitality. They have gone all out to make our visit a fruitful one. We appreciate it.

Again, I want to thank Chairman Train of the President's Environmental Council and all the members of the committee and the staff for their attention to this very important problem of ocean dumping off the shores of our mid-Atlantic States.

Thank you very much.

Senator MUSKIE. Thank you, Senator Boggs.

I think it would be appropriate to read a message from Senator Randolph, Chairman of the full Committee on Public Works who had planned to be here but because of circumstances cannot be here. I would like to read his message:

"I deeply regret that circumstances have prevented my attending the ocean dumping hearing in Rehoboth as I had planned. I share your concern with that of the other members of the Subcommittee on Air and Water Pollution regarding the critical issues involved and the urgent need to enact legislation to prohibit the use of our oceans for dumping liquid and solid wastes.

"I desire to state for the record while the Hon. J. Caleb Boggs is on official business in the State of Delaware, that there is no more diligent or effective member of the subcommittee or the full Committee on Public Works since I have been chairman. I know of no member of the committee who has been more constant in his attendance at hearings and in executive sessions, nor has there been any member who has been more constant in keeping the public interest always in view.

"S/JENNINGS RANDOLPH."

Senator Case and Senator Roth will testify today, and I would like at this point to give other members of the subcommittee an opportunity to say whatever they would like to say at the outset.

Senator Beall?

**STATEMENT OF HON. J. GLENN BEALL, JR., MARYLAND, MINORITY
MEMBER OF THE SUBCOMMITTEE ON AIR AND WATER POLLU-
TION**

Senator BEALL. Thank you, Mr. Chairman.

In the interest of time I have a statement which I will present for the record.

I would like, as a resident of Maryland, to thank you for coming down to Delaware and participating in these hearings; and I would like to thank our colleague, Senator Boggs, our good neighbor, for arranging this kind of a hearing because we are both very proud—he of Rehoboth Beach and I of Ocean City—of the tremendous recreation potential that exists at these two resorts, and for all the people up and down the eastern seaboard. I think this is an opportunity for us to stop pollution before it does damage to the potential that exists. I think this hearing is an indication that we are ahead of the problem and I am happy to be able to participate in these hearings this morning.

Mr. Chairman, it is a pleasure to be here today. One of the most valuable natural resources that we have in the State of Maryland is the beach at Ocean City. Certainly the clean water and the pure sand at Maryland's ocean resort provides one of the best recreational opportunities on the east coast of the United States.

Because it is still clean, Ocean City provides an opportunity for us to protect an area from pollution so that its use is not lost to the great number of Marylanders and others who enjoy its benefits as has been the case for so many other recreational areas across the country.

For this reason, I joined with Senator Boggs of Delaware and other members of the Subcommittee on Air and Water Pollution of the Senate Public Works Committee to hold hearings today in Rehoboth Beach on the subject of ocean dumping.

We have been alarmed recently to read and hear of sludge and garbage scows being towed out into the Atlantic Ocean and then dumping refuse which might eventually wash up on our shores. While this doesn't appear to present any immediate problem to Ocean City, it is something we want stopped.

The oceans comprise over 70 percent of the earth. The Statton Commission Report, "Our Nation and the Sea" emphasized the importance of the sea when they said "the Nation's stake in the use of the sea is synonymous with the promise and threat of tomorrow." The promise of the ocean is represented by:

The ocean's potential as a source for food for a growing world population;

The ocean's potential as a resource for new minerals;

The potential for the ocean's plant and animal life for the medicinal raw materials; and

The ocean's importance in providing transportations, recreation, and a refuge from hectic pace of urban living for many Americans.

The dangers are represented by the National Security implications such as submarine warfare, and the purpose of the hearing today—ocean pollution.

I, for one, want to take this opportunity to applaud the President's Council on Environmental Quality for its report, "Ocean Dumping, a National Policy," which was issued to the country in October 1970. The report gave emphasis to the concern and prompted the legislative activity and the subcommittee's hearings today. (See appendix for report.)

We know what can happen if dumping goes uncontrolled as illustrated by the so-called Dead Sea area, a contaminated ocean area off the New York Harbor. We are determined to prevent additional such areas, particularly off the Maryland-Delaware beaches. That is why we are concerned over the 140 million gallons of sludge, 110 million by the city of Philadelphia, dumped at the Cape May-Delaware ocean sewage dump.

Although the amount of waste transported and dumped into the ocean is relatively small in terms of the total volume of pollutants reaching the ocean, indications are that the future impact of ocean dumping will show a marked increase relative to other sources, unless steps are taken and taken now.

About 48 million tons of waste were dumped into the oceans in 1968 at 250 disposal sites, 50 percent of which are located off the Atlantic Coast. This waste includes dredge spoils, industrial waste, sewage sludge, which is a by-product of municipal waste and water treatment, construction and demolition debris, solid waste and radioactive waste. Projections indicate that the volume of waste dumped into the ocean is increasing rapidly and will likely increase even faster because of the decreasing capacity of present facilities, the lack of suitable nearby land areas, and the higher costs and political problems in acquiring new sites.

Statistics compiled by the President's Council indicate a fourfold increase in ocean dumping from 1949 to 1968. Both the 1959-63 and 1964-68 periods showed a 28-percent increase in waste disposals at sea, largely resulting from dramatic increases in industrial and sewage sludge disposals. A study of population projections also indicate that the problem is likely to become more acute because more people simply mean more waste. Between 1930 and 1960 the population of our coastal areas increased by 78 percent compared with a 43-percent increase for the Nation as a whole. In 1970 our coastal population was estimated at 68,397,000, and by the turn of the century our coastal population is estimated to reach 106,900,000, a figure as great as the total population of the Nation 50 years ago.

Using the projected population increases for coastal areas, and assuming 0.119 lb. of sludge generated per person each day, one can estimate the potential sludge disposal of our coastal areas. It is estimated that last year 1.4 million tons were disposed at sea. By the year 2000, the number of tons generated in coastal areas will increase 50% to 2.1 million tons. The President's Council cautioned that this may underestimate future amounts of sludge, pointing out for example, that in the Baltimore-Washington area the sludge generated will increase 140% from 70,000 tons to 166,000 tons.

I might say that we are deeply indebted to the President's Council on Environmental Quality who recognized not only the importance of the problem but also the need for an early and thorough report on ocean dumping. Only named in April 1970, the Council completed its study and issued an excellent report in October of last year. At

this time President Nixon endorsed the Council's recommendations, as do I, and indicated that he would send legislation to the Congress on this subject. Present legislation and regulatory authority is inadequate. Many States have no controls over the ocean dumping, a State's jurisdiction extends only to the territorial sea, out three miles. Corps of Engineer's regulatory authority in general has the same limitations.

On Tuesday, March 16, I joined Senator Boggs and others in introducing the administration bill S. 1238, the Maritime Protection Act of 1971 which would require permit for discharging of waste into the oceans. The bill declares and provides legislative authority for a national policy to regulate the dumping of all types of material in the oceans, coastal and other waters and to prevent or vigorously limit the dumping into the oceans, coastal and other waters of any material which could adversely affect human health, welfare or amenities, or the marine environment, ecological systems, or economic potentialities. I am hopeful that the Public Works Subcommittee on Air and Water pollution will take early and favorable action on this legislation.

Mr. Chairman, I believe that the American people should take heart over the developments in the environmental area. Although we certainly have not won the battle, we are committed to winning it. This very hearing illustrates that the President and the Congress are beginning to take action in anticipation of emerging environmental problems rather than responding to them after the problem has reached a crisis or disaster state. As the Council states, "The Nation has an opportunity unique in history—the opportunity to act to prevent an environmental problem which otherwise will grow to a great magnitude."

In closing, Mr. Chairman, I believe the waste disposal is one of the most complex and critical problems facing this country. Finding a solution to the problem is going to require the mustering of the best minds and talents available in America. The waste problem was summed up in a recent committee executive meeting when one Senator remarked, "Everyone wants us to pick up the waste, but no one will let us put it down." We simply must find better means of handling our waste materials. That is why I am deeply interested in recycling of waste. I believe recycling will prove more important in the years ahead. Recycling simply must become a part of our general practice. It is my undersanding the technology exists today to recycle many types of paper, glass, aluminum, and various materials. Also, I understand that 19 percent of the material used in the paper manufacturing process is recycled.

Certainly we need an accelerated solid waste research program to produce new and needed technology in this area. This is important not only in helping to solve the vast and growing waste disposal problem, but also because there is a real need to conserve and use wisely our resources. After all, our resources are not inexhaustible.

I have been following with great interest the Federal research project in Prince Georges County which involves the recycling of household waste. It is my understanding that the labor, equipment, and building to process the waste is running \$3.25 a ton. This indicates we may be able to turn the liability of waste disposal into a profitable national asset.

I ask unanimous consent that a Sunday Star article of January 17, 1971, on this effort be made part of the record at the conclusion of my statement.

Only recently, the Maryland tin companies of American Continental, and National Can announced they would commence a joint effort in recycling metal cans. One of these collecting centers is to be located in Dorchester County. It will be the first recycling center on the Eastern Shore. Reportedly six recycling centers will be operating in Maryland, three in Baltimore, one in Sparrows Point, and two in Dorchester County.

I cite these developments as indicative of some of the developments and activity in the waste disposal field. Industry, cities, Government and, yes, private citizens are all part of the problem and therefore all must be a part of the answer. Since paper products make up approximately 50 percent of solid waste and paper can be recycled, there is a great potential here not only for conservation of our resources, but also for easing of the waste disposal problem.

I am convinced that a concerted effort by all, preventative actions such as those represented by today's hearing, and an acceleration of research on recycling, will produce the breakthroughs necessary for us to deal with the mountainous problem of waste disposal.

I am pleased to be here and pledge that I will do everything I can to make certain that the potential of the ocean as a food source, as the habitat of fish and wildlife, and as a source of transportation, recreation, and fun will be preserved for millions of Americans today and for posterity.

(Article from Washington Sunday Star follows:)

[From the Washington Sunday Star, Jan. 17, 1971]

CAN WE USE MAX SPENDLOVE'S TRASH MACHINE?

Our refuse need not be a mountainous liability. It can be disposed of profitably, says the director of an experimental recycling plant in Maryland.

(By John Morton)

A quart jar of pickles brings together in one convenient package 16 pickles, a cup of brine, an ounce of metal in the cap, a bit of paper label and 12 ounces of glass. All of these facts do not fill the housewife's mind as she cruises the supermarket aisles. It's the pickles she wants, and that's what her family gets. The rest is thrown away.

A lot of everything else she buys is thrown away, too, after the edible contents are unwrapped from paper, squirted from aerosols, squeezed from tubes and poured from thousands of cans and nonreturnable glass bottles. Truly it is a disposable feast.

Americans throw away 150 million tons of household refuse annually, and the total goes up each year. The cost to collect and dispose of it is staggering—close to \$4 billion annually. Some of the junk is burned, some is buried, some is dumped at sea, and a lot of it just blows across the land.

The harvest of refuse is a major headache for cities, which everywhere are plagued by a lack of new dumping sites and the high cost of building and running refuse incinerators. Yet this effluent of our hardsell, super-packaged marketing system itself offers the answer to the problem of its existence. For if properly treated, all of this junk is worth money.

A federal research project quietly underway in Edmonston, Md., in Prince Georges County, has developed a recycling plant that takes refuse at one end and produces commercially valuable products at the other end—at a profit. The reason a profit can be made is simple: Household refuse is rich in all the materials that were thrown into it—aluminum, iron, copper, brass, tin, glass, paper and plastic. Indeed, for some of these materials, household refuse is a resource richer than ore that is profitably mined and processed in a mill.

A visit to the Edmonston recycling plant is a surprising experience for anyone accustomed to the dirt and obnoxious smell usually found in ordinary refuse-disposal plants. There is plenty of noise—the huge machines used in the recycling

process chop, tumble, crush and shake the junk fed into them with an awesome racket. But the refuse is carefully contained along the chain of connected machinery, and water sprays used in the machines to wash out fine particles keep down the dust. The floor is spotless.

The man in charge is Max Spendlove, research director at the U.S. Bureau of Mines' Metallurgy Research Center at the University of Maryland. Spendlove, a serious-faced, orderly man in his 50s who looks as if he might be a high school physics teacher, has a matter-of-fact way of speaking that often harbors wit. Giving directions to this office on the University of Maryland campus, he advised: "Follow Campus Drive until you pass the Student Union Building—that's the one with all the trash out in front—and I'm in the next building on your left."

Spendlove's career as a government metallurgist devoted to getting something valuable out of what appears to be worthless goes back to 1940, long before the disposable explosion in American merchandising began overwhelming municipal trash systems.

His first job with the Bureau of Mines was to figure out a way to extract the valuable metal in the smoke and gases belched out by copper smelters near Salt Lake City, Utah. After World War II he was in College Park, developing techniques for reclaiming aluminum from thousands of scrapped military planes. When Congress enacted the Solid Waste Disposal Act of 1965 with the idea of combating pollution and reclaiming lost resources, Spendlove was appointed to direct the bureau's research under the act. This led to the development of the Edmonston recycling plant, which first started processing refuse on an experimental basis in May, 1969.

So Spendlove is used to looking at the worthless, the discarded objects of America, in a different light. Thus he speaks of household trash with admiration, even a bit of affection, and with an absolutely straight face. To Spendlove, it's not trash, but "urban ore," and he likes to talk about coat hangers and tin cans are "high" in iron, that broken toys and alarm clocks produce a lot of brass and aluminum, and that all of those throw-away bottles give off a nice quality of marketable glass, if handled right.

He even sounds a little protective of the qualities of his urban ore at the mention of banning throw-away bottles by municipal ordinance, a step recently taken by Bowie, Md.

"What good does it do to ban throw-away pop and beer bottles and not ban them for pickles, vegetables, ketchup, olives and everything else that comes in a throw-away container?" he asks. "What about the shoe box and all the other containers we throw away? Besides, the consuming public will always resist this. They'll just go buy them somewhere else."

Let the people buy and throw away, says Spendlove. Human nature is not easily changed, but recycling plants that make money can be easily built, and the profits can be spent on doing a better job of collecting refuse.

Trash disposal in the United States, for the most part, relies on the same basic processes used centuries ago—burn and bury. Nothing better was ever developed because, until fairly recently, land was cheap enough and plentiful enough to make burn-and-bury a sensible disposal system.

But suburban sprawl, the population explosion and the boom in throw-away packaging have combined to overwhelm existing municipal dumps and make sites for new ones hard to find. Fairfax County in Virginia, for example, is nervously seeking a new dumping site; in about a year, the county's landfill operation west of Fairfax City will have taken about all it can hold.

Similarly in Maryland, Montgomery County should have closed its overstuffed landfill near Rockville a year ago, county officials acknowledge. But land close in is expensive, and few communities farther out are eager to become somebody else's dumping ground. Alternatives being considered by some local governments include bailing trash and shipping it elsewhere by rail. The District of Columbia may send its trash on barges 20 miles down the Potomac to Cherry Hill, Va., when its dumping site at Oxon Cove, Md., is filled up.

One method of reducing the sheer volume of refuse is to burn it in an incinerator, which removes the paper, plastic, wood, food, and anything else that will burn. There are now about 400 incinerators in use in the United States, and scores more will be built in coming years. The District has had at least one incinerator since the 1930s, and is planning to build its fifth soon. And there are several others in metropolitan Washington. But incinerators still leave an unburnable residue of metal and glass that must be buried in a landfill somewhere.

The Edmonston recycling plant developed under Spendlove's direction was designed to process this incinerator residue—extract the valuable materials in pure enough form to make them commercially valuable. Using residue collected from

incinerators in suburban Maryland, Virginia, the District of Columbia, Baltimore, Atlanta and New Orleans. Spendlove and his fellow researchers experimented with machines that chopped, chewed and separated incinerator residue. By November, 1969, six months after they started, they had perfected the process.

Perfecting the process achieved these financial results: The cost in labor, equipment and building to process incinerator residue is \$3.52 a ton. The end products—commercial grade metals and glass—are worth \$12 a ton. This means that cities with incinerators are burning and burying \$77 million worth of resources a year—the recycled value of the 22 million tons of refuse fed to incinerators each year in the United States.

Attracted by reports in technical journals, representatives from the iron, aluminum and glass industries have visited the Edmonston project to see for themselves that the recycling plant can produce valuable material. Other visitors have included officials from several major cities in the United States and abroad.

If money can be made from household trash, and the Bureau of Mines has a plant that proves it, why aren't mayors and city councils all over the country plunging into engineering reports and making feverish plans to build their own recycling plants? Part of the answer is that the Bureau of Mines experiment was so recently completed that word of its successes has not spread out to municipal public works departments. Even in metropolitan Washington, which would seem to have the edge on the rest of the country because of proximity, checks with public works departments failed to turn up any officials who had actually visited the Edmonston project, although there were varying degrees of awareness of it.

Moreover, the public works officials tended to view the whole concept of recycling as something too experimental and far off to be of much use to them in their day-to-day struggles with collection, burning and burying. Says Norman Jackson, director of the District's Department of Sanitary Engineering: "Recycling is a very fundamental principle that we must observe in the future, but I think a lot of work remains to be done on it."

Others apparently were not acquainted with Spendlove's recycling techniques. Both Nicholas Stoliaroff, urban engineer with Prince Georges County, and Frederick Doe, Arlington County's utilities director, asserted that household trash is such a complex mixture of materials that sorting it out never would be profitable. "You can't tell from looking at a can whether it's aluminum or tin," says Doe. The Edmonston plant, however, does not rely on visual identification; it shreds all incoming materials and separates them with mechanical, magnetic and chemical methods.

Doe also refused to accept that tin cans and glass bottles could produce raw materials that would bring a profit, regardless of the cost-profit studies done by the Bureau of Mines. "For example, tin cans have fallen in value considerably because the tin coating on the iron contaminates the new types of steel furnaces being used," he says.

Spendlove acknowledges that the tin contamination problem remains to be solved, along with problems caused by solder from the seams of cans and copper that somehow attaches itself to tin cans during incineration. But the profit figures he cites for his recycling process are based on receiving the low prices that tin-contaminated iron brings on the market. "When we solve the contamination problem, the iron will be good enough to make steel, and then we can make more than \$12 a ton profit on incinerator residue," he says.

Spendlove believes there will be two major barriers to overcome before very many communities will be able to put to work the recycling process developed in Edmonston. "In many cities, just getting out from under the refuse-disposal problems that they have right now will put them off," he says. "And I am assuming that, whenever a recycling plant is built, it will be a combined effort—a combination of city and state or federal governments, and perhaps even some private interest. None of these relationships has been determined, and it will take time. But I'll be surprised if some serious proposals don't start coming in."

As for the recycling process itself, Spendlove emphasizes that no esoteric machinery or unusual new processes are involved. "All the machinery we use is conventional," he says. "We just use the basic minerals-processing techniques, but we've brought all the techniques together to work on urban ore."

There are three basic operations: 1. Shredding and grinding the incinerator residue into small particles. 2. Separating out different materials with magnets and screens of different sizes. 3. Washing to remove dust particles.

The first machine in the recycling chain is a trommel—a large, rotating cylinder full of 1½-inch holes that normally is used to sort out gravel. The incinerator

residue brought in at the unloading dock is dumped onto a conveyor, which carries it to the trommel; small particles drop through the trommel's holes as it rotates and feeds larger pieces to a shredding machine. In later stages, magnets pull out magnetic metals, and grinding mills crush glass into tiny particles and flatten pieces of nonmagnetic metals so they can be screened out of the glass.

Traditional refining techniques, such as acid leaches and filtration, further separate metals into aluminum, copper, zinc and brass. The glass particles can be used as is to make building bricks and glass wool, but more money can be made from glass that is separated by color, which is done both by magnetic means (color in glass is created by iron and chromium) and with an optical sorter.

The cost and profit figures cited above are based on a recycling plant serving a city of 250,000. A larger plant, say for a city of a million, would use the machinery more efficiently, reducing processing costs to \$1.83 a ton. How much to build a plant for a city of a million? About \$2.2 million, certainly not unmanageable, especially in view of the profit potential.

"Now that we know how to process incinerator residue and make money at it," says Spendlove, "we're setting up another plant to take refuse straight from the garbage can—no incinerator—because the paper and plastic refuse is valuable, too, and we hate to see it burned up." He expects to spend about a year perfecting the process for raw refuse. "We already know how we hope to do it, but there are always unexpected kinks to work out."

OFFICIALS TEND TO VIEW THE CONCEPT OF RECYCLING AS TOO EXPERIMENTAL

Processing raw refuse both eliminates and raises some problems. It would eliminate the need for an incinerator which costs about \$23 million to build for a city of a million. But it poses expensive difficulties in reclaiming paper and plastics and fabrics. To be separated from other trash, these lightweight articles must be put through what is called air classification.

Essentially, air classification is a stream of air into which the refuse is dribbled. The air blast blows out the paper, cardboard plastic and other light materials, and an additional air stream can further separate the lightweight materials into distinct grades.

Adding air classification to a recycling plant (the heavier materials would continue to be processed just like incinerator residue) would raise the cost of a plant for a city of a million to about \$7.2 million.

This more sophisticated, raw-refuse process is yet to be perfected, however. But Max Spendlove says it's just a question of time. Working on the mechanical problems involved is simple, compared to the obstacles in other phases of waste management—for example, taking almost invisible pollutants out of air and water. "Solid waste is easy to work on" says Spendlove. "You can put your hands on it. You can do almost anything you want with it."

Senator MUSKIE. Thank you, Senator Beall.

I am delighted that another member of the subcommittee, Senator Buckley of New York, is also with us. I would like to invite Senator Buckley to make a brief statement.

Senator BUCKLEY. Thank you, Mr. Chairman.

I, too, am delighted to be here. I believe that these hearings will be immensely important and I hope fruitful when, as Senator Beall suggested, we have the opportunity to head off what could be a biological catastrophe. I think we are only recently aware of the importance of the estuaries to the production of most of the fish and other foods that we derive from the ocean. We can apply preventative ecology in this instance, and I am delighted to be here with the subcommittee.

Senator MUSKIE. Thank you, very much, Senator Buckley.

Now we turn to the witness list. Our first witness is the most senior Senator present. It has been my privilege to serve with him in the Senate some 12 years. I have come to hold him in high regard, not only for his personal qualities but also for his abilities. He is a Senator from one of your adjoining States, Senator Clifford Case of New Jersey. I am delighted to welcome him as the first witness on our list.

**STATEMENT OF HON. CLIFFORD P. CASE, A U.S. SENATOR FROM
THE STATE OF NEW JERSEY**

Senator CASE. Thank you, Mr. Chairman.

Members of the subcommittee, ladies and gentlemen. It is a great pleasure to be here. I, too, am an old-time colleague of your former Governor and Member of the House and now Senator Caleb Boggs, and we all appreciate his hospitality and the hospitality of his colleague, Senator Roth your new Senator who is such a bright addition to the membership of this, what is called sometimes jokingly, sometimes seriously—of course, we, who are Members of it, always think appropriately—"the most distinguished group of legislators in the world."

Seriously, we appreciate the opportunity to come here, and I am grateful on behalf of my colleague, Representative Sandman, who is sitting down at the other end of the table, who so well takes care of the southern tip of New Jersey, and that he has decided to continue doing it in the face of some suggestion that he might be aspiring to represent the whole State. [Laughter.] That is something that somebody put in his mouth and he didn't say at all. That is for the Jersey papers. Charlie.

But it is serious, Mr. Chairman, so serious that all of us here from this whole area, including New Jersey, want to make it very strong on the record.

Those representing us here in addition to our representative from the district which takes in Atlantic and Cape May Counties, as well as others; representing our State, Richard J. Sullivan, commissioner of the New Jersey Department of Environmental Protection. He has the responsibility of protecting the environment in New Jersey.

Others who came to express their concern over ocean dumping because their lives have been directly affected by it. In this latter group are Wilbur J. Ostrander, city commissioner of Wildwood, N.J., a very effective public servant and a moving force in the Stop Ocean Dumping Association, or SODA.

Anthony Bianchi representing the Greater Wildwood Hotel and Motel Association; Louis Rodia, president of the Ocean Highway Association, Cape May, N.J.; Mayor Charles Masciarella, Wildwood; Capt. Otto Stocker, Wildwood, another leader of SODA, Warren Lund of Cape May and Peter Lamonica of Cape May.

Mr. Chairman, I will try to avoid relating to the subcommittee information which these residents of New Jersey are in better position than I am to give as they have learned it from first-hand experience, and I am most happy that such a large number of New Jerseyans were able to get here for this terribly important hearing.

While ocean dumping is a national and even an international problem, those of us from New Jersey have a special concern with the practice of disposing of wastes at sea.

New Jersey is the most urbanized and the most densely populated State in the Nation. It is surrounded by such densely populated areas as Metropolitan New York and Greater Philadelphia. This concentration of population generates huge amounts of wastes and places premium values on land areas suitable for disposal of these wastes.

As a result an estimated 88 percent of all ocean dumping by the United States occurs along the New Jersey coast.

The President's Council on Environmental Quality has warned that ocean dumping will become a serious problem on a nationwide basis in the future if something is not done to halt it now.

To our coastal areas generally, a massive increase in the already growing level of wastes that are dumped into our oceans and the Great Lakes represents a threat of widespread environmental deterioration.

To New Jersey and its neighboring States, it is more than a threat.

In the 7 years between 1962 and 1969, the amount of fish taken by commercial fishermen from the ocean waters off New Jersey and New York decreased by more than a half billion pounds—from 673 million pounds to 133 million pounds.

While comparable figures are not available for the catches of sport fishermen, they may have had even worse luck because commercial fishermen probably used improved techniques to a greater degree to offset reduced abundance.

The commercial fisheries have been particularly hard hit by a decline from 514 million pounds of menhaden caught in 1962 to a 1969 catch of 44 million pounds of this nonfood but commercially valuable fish. The food fish catch dropped from 159 million pounds in 1962 to 89 million pounds in 1969.

During the same period oyster production off the New Jersey and New York coasts dropped from 2,300,000 to 1,300,000 pounds. In 1931, the oyster harvest from the same waters was 21 million pounds.

Unfortunately, in the last year the Federal Food and Drug Administration has been forced to close areas off New York Harbor and Delaware Bay to shellfishing because the shellfish have absorbed from wastes dumped into the oceans disease-bearing organisms which can be transmitted to human beings.

To those who make their living from the waters off New Jersey, the problem is serious—indeed critical—now. And as we seek to clean up our land areas, the pressure to further contaminate our oceans will inevitably increase.

In New Jersey, for example, many of our sewage treatment plants are expected to be converted to secondary treatment of wastes by 1975. As these secondary treatment plants begin operating, they will produce new mountains of sludge like that which is now being dumped into the ocean. The more efficient the plants become, the more sludge will be generated.

The problem is more acute in New Jersey than elsewhere now but it is easy to recognize that it is only a matter of time before others along all of the coasts of the United States will experience similar, if not worse, problems.

It is time we adopt a national policy to control effectively the dumping of wastes which already have turned some offshore areas into dead seas incapable of supporting any form of life.

The subcommittee has before it six different proposals for control and regulation of offshore dumping. One of these is a bill, S. 1082, which I introduced and is cosponsored by the chairman of this subcommittee and the ranking Republican on this subcommittee, as well as five other Members of the Senate.

Our bill would ban the dumping of waste between the shore and the edge of the Continental Shelf during the first 5 years and would prohibit all dumping of wastes into the oceans and the Great Lakes after that 5 year period.

, And I would particularly call attention to one other provision of S. 1082. This provision authorizes the Administrator of the Environmental Protection Agency to conduct and encourage research into means of recovering useful materials from waste and disposal of wastes in a manner that will not endanger the public health and welfare. The agency also may give financial and other assistance to appropriate public and private agencies to conduct research and demonstration projects.

In some cases, feasible and economic land-based disposal methods already are available for wastes currently being dumped into the oceans and the Great Lakes. For example, sewer sludge contains phosphorous, nitrogen and potassium, the basic ingredients of fertilizers used by farmers. Present day technology allows treatment of sewage to a sufficient degree to permit the use of the sewer sludge safely to make crops grow. In cases such as this, the authority given to the Administrator would help to make the latest methods known to those who need them and demonstration projects will show their utility.

The authority for research and demonstration projects in S. 1082 is modeled after similar provisions in the Resource Recovery Act of 1970. But the 1970 Act applies only to solid waste. Our bill would apply this authority to all wastes currently being dumped in our oceans, whether they are in solid, liquid, or other form.

I call special attention to this authority in S. 1082 because I do not believe the problems of combating pollution which we face can be solved unless we can provide feasible alternatives to the practices that are causing our problems. We just can't say "no" to this business and stop it. You have got to provide other ways of handling the wastes that are increasingly the product of our highly developed civilization.

Current practices came into being because they met a need. They will not be easily abandoned unless we can offer a better way to meet the need. And what better way can there be than by finding a way to put our wastes to some useful purpose?

In other sections, S. 1082 incorporates provisions of legislation introduced in the House of Representatives by Congressman Charles Sandman, who is also here to discuss the problem of ocean dumping. By controlling the disposition of wastes at the loading site, these provisions make it possible to control dumping anywhere in the ocean waters or the waters of the Great Lakes. Other bills dealing with ocean dumping are limited in jurisdiction to an area extending 12 nautical miles from shore.

During the first 5 years after its enactment, S. 1082 would ban dumping in the area where it is most serious, between the shore and the edge of the Continental Shelf.

But it goes on from there. It recognizes that eventually all ocean dumping must be halted because it will damage our ocean resources even if dumped beyond the Continental Shelf. At the end of 5 years, S. 1082 would prohibit the loading of wastes in ports in this country which are to be dumped anywhere in the waters of the oceans or the Great Lakes.

The six bills before the subcommittee are not competing with each other. It is my hope, and I am sure the hope of the sponsors of all the bills, that the subcommittee will work out the best possible bill, drawing on all the proposals that have been submitted.

My colleague, Senator Williams, has cosponsored S. 1082 in addition to submitting his own bill, S. 1011, which contains a provision that would make Federal grants available to States and municipalities to help cover increased costs of disposing of wastes that had previously been dumped in the oceans. I hope the subcommittee will give this provision careful consideration.

Eventually, international cooperation will be needed to preserve our oceans. In my view, the best way to stimulate this international cooperation is for this country to set an example by demonstrating that ocean dumping can be—and will be—halted.

I commend the subcommittee for its interest in this problem and I appreciate the consideration that will be given to S. 1082.

Senator MUSKIE. Thank you very much, Senator Case.

Really, the problem of associating a Senator's name with legislation is not so much, in this field, traceable to partisan consideration. It could be when we become sensitive to our own problem. Senator Case faces reelection campaigning in 1972—

Senator CASE. How nice of you to mention it. [Laughter.]

Senator MUSKIE. And we just don't believe that any senator facing that problem wants to be associated with the concept of dumping. [Laughter.]

Senator CASE. This son of a gun is a pistol. We sat together on the plane coming down here from Washington, what did he pull out of his briefcase but a joke book. He is getting ready to campaign. [Laughter.] And there are a bunch of very good ones, I copied three or four for myself.

Senator MUSKIE. It is nice of you to mention campaign. [Laughter.]

I am delighted to welcome as our next witness your junior Senator from Delaware, and I use the word junior without any suggestion of denigration because I am still a junior senator after 12 years. I think it is a pretty exalted station.

I have not had an opportunity to get to know your new Senator well but I look forward to it, and it is a pleasure to welcome him this morning as the second witness.

Senator Roth?

STATEMENT OF HON. WILLIAM V. ROTH, A U.S. SENATOR FROM THE STATE OF DELAWARE

Senator ROTH. Mr. Chairman, I too, would like to join my senior colleague, Senator Boggs, in welcoming you and the other members of the subcommittee. It is indeed a pleasure to have you here. We are very proud in Delaware of the work that your subcommittee has done, and I might say, under your very capable leadership; and if I may take a little parochial pride, under the strong and effective leadership of Caleb Boggs.

Something has been said about elections in 1972. I might point out that at least three of us here have no concern for 6 years. We have two other freshman Senators here with us and I particularly want to welcome Glenn Beall and Jim Buckley who have the onerous duty of presiding over the Senate floor as a freshman.

But I think the fact that we have such a large crowd here, Mr. Chairman, indicates the very real deep concern the people of this area have in the problem of ocean dumping. I do not, of course,

suggest that this problem is one which is or should only be of concern to residents and representatives of the coastal States, and the list of cosponsors of the proposed Marine Protection Act of 1971—which I am privileged to cosponsor with the chairman and my colleague, Senator Boggs—makes that clear. When we see Senators from both coastal areas, and noncoastal States such as Ohio, Kentucky, and Idaho, sponsoring legislation to control ocean dumping, then we know we are dealing with a problem that is not only regional in nature but national in scope.

Nonetheless, I do have a particular interest in the immediate effects that ocean dumping has on my State of Delaware, and I know it is a concern which we all share today. Delaware rightfully regards the beautiful stretches of ocean front as a magnificent national asset and the fact that it has been long known, as prior speakers have brought out, as the Nation's summer capital indicates recognition on the part of many others. There is no question but that we do consider our coastal area a most important element in the economy of our State. More than that, we consider it a priceless and productive resource entrusted in our care for the benefit of all Americans who choose to visit with us, and I believe our State's efforts to protect and preserve this valuable area with a shoreline plan is convincing testimony to our desire to save the ocean for the benefit and the enjoyment of all.

We in Delaware are vitally concerned—and I use the word “vitally” in the true dictionary sense of the word, that is dealing with life itself—with the effects that unlimited dumping and unregulated dumping in the ocean can have on our shoreline, and in turn on our economy. We are concerned with the disastrous effects it can have not only on the shoreline but we consider it for recreational purposes, but also the disastrous effects that it can have on the shellfish industry upon which many of our citizens depend for a livelihood.

We are concerned in a larger sense that the effect of indiscriminate ocean dumping can have on marine life which does not directly relate to the economy of this State.

We know that five designated dump sites exist off the entrance area of Delaware Bay. The closest is 11 miles due east of Rehoboth Beach, where the cities of Philadelphia, Camden, N.J., and Bridgeton, N.J., annually dump an estimated 140 million gallons of sewage sludge. This site has been used for sewage sludge for approximately a decade. Approximately 11 barge trips a month are made to this site for disposal of sewage sludge.

The Food and Drug Administration has declared off limits for the harvesting of shellfish an area 6 miles in radius from the center of this sewage sludge dump site. FDA says it cannot enforce such a closure, but relies on the voluntary cooperation of shellfishermen. FDA can, however, prevent the landing and sale of contaminated shellfish taken from this area, or any other.

Thirty-seven miles offshore, and a bit farther south, is an acid dump site used by industry for approximately 11 barge trips a month. The Corps of Engineers says there are five Delaware Valley industries that barge wastes to sea.

Dump area No. 3, used for industrial salts is farther to the southeast, approximately 47 miles from shore.

Ninety-seven miles offshore is another dump site for industrial wastes.

The fifth dump area is for disposal of arsenic compounds, and is located on a random basis 200 to 300 miles from shore.

These thoughts, Mr. Chairman, lead naturally in three directions. The first deals with the need to control immediately ocean dumping which we know to be harmful; second, we need to learn a great deal more about the long-range effects of ocean dumping; and third, we need to consider the fact that ocean dumping is an international problem.

The recent report of the Council on Environmental Quality made it perfectly clear that there is a critical need today for a national policy on ocean dumping. For that reason, I was pleased to join many other Senators sponsoring legislation—S. 1238—to prevent harmful ocean dumping. This bill, along with Senator Muskie's proposal, S. 523, essentially would permit the U.S. Government to regulate what is dumped into the oceans insofar as the material to be disposed of originates in the United States, by requiring permits to transport materials to predesignated dumping sites.

The enactment of such legislation would be a significant step toward alleviating a potential crisis in our oceans. Insofar as the Federal Government is concerned, I believe it to be most important that complete authority to regulate and manage the disposal of waste in the oceans be vested in one agency, and that agency should be the Environmental Protection Agency whose primary mission is to protect and enhance our environment. Fairness and efficiency demand that our municipalities as well as industry should only have to deal with one Federal agency rather than a multitude of agencies in processing applications for disposal of waste at sea. It is also important that our Federal agencies, including the military should comply with Federal regulations in disposing of waste in the oceans. There are exceptions such as those that arise during wartime emergencies, but these should be spelled out either in the legislation or established by Executive order.

I also believe that the legislation should be precise in granting authority to designate areas in which all dumping is banned. This is particularly important to those of us living on or near the Delmarva area. As I have already indicated a number of dumping practices off the coast of Delaware have developed that endanger not only our shellfish industry but a recreational area used by millions of Americans living in the Mid-Atlantic section of the United States. It is critically important that all agencies public or private, be immediately prohibited and I emphasize the word "immediately," from dumping in all areas endangering our shorelines and coastal areas.

If practical, it would be desirable to have a complete moratorium on ocean dumping until such time as adequate criteria could be established for setting standards for disposing of material in the sea. Undoubtedly, the larger nearby cities will insist that they need to continue to dispose of their waste in the ocean. If they are to be permitted to continue to do so, then it is essential that they be required immediately to carry it out far enough to sea that it does not threaten our coast lines. The question of whether this should be off the Continental Shelf, 100 miles out to sea, or elsewhere, I think should be based upon the best possible scientific advice available.

In that regard, I would like to make particular mention of the newly formed college of marine studies at the University of Delaware under Dr. William Gaither. I know this school will be of great value to Delaware and the nation in providing the technology required to solve the waste management problem which we face today and the effects of waste disposal in the oceans. I strongly recommend that its facilities be utilized in a cooperative effort to learn more about protecting and safeguarding our invaluable waterways and marine life.

At the same time, the work being done by the State of Delaware on a broad recycling plant is a development which deserves a great deal of attention. Recycling is, I think, the solution to most of our solid waste disposal problems and I am pleased with the leadership Delaware is providing in this area. I would hope that the Federal Government would work closely with both university efforts such as those being made at the University of Delaware and the State of Delaware in its search for solutions to these problems.

Another suggestion that I would like to make is that the problem of ocean dumping be placed within the broader perspective of overall environmental management of the coastal zone. It is apparent to me that disposal of wastes at sea is attractive to those who are close to the ocean and are tempted to choose this relatively inexpensive method of waste disposal. It is also apparent that we cannot consider waste disposal in the ocean separate from the use of land for waste disposal. Recycling of materials and reclamation of resources is an intrinsic and inseparable part of the alternative to ocean dumping. Here again, as I indicated earlier, the State of Delaware is providing leadership. In short, my point is that these various identifiable problems are really only different facets of the larger problem of living in harmony within the natural environmental system of which man is a part. What we do with any part of the system can and does have an effect on other parts. It is futile to assume that piecemeal approaches to the whole problem of environmental management will result in satisfactory solutions. We must, in enacting the urgently needed regulations to halt promiscuous and thoughtless destruction of the environment, proceed in a way which will result in the preservation of the environment while maintaining the productivity essential for the well-being of man. The disposition of wastes will have to be coupled with the use of resources at all phases of their development. The President has recognized this fact of life in his environmental message and has put forth a program which would accomplish the overall approach to environmental management so urgently needed if we are to have a world that is livable for us and for our children.

A few moments ago I indicated that there were three major areas of concern to which we as legislators must direct our attention. The first and second I have already mentioned; namely, the effects of, as well as the alternatives to, ocean dumping and the need for an immediate ban on known harmful dumping. The third is the need for consideration of controls which exceed our own national jurisdiction.

In this respect, ocean dumping is not, of course, simply a national problem. Long range it would do us no good to completely prohibit the transportation of material from the United States which is intended to be dumped into the oceans if other nations are free to do the very things which we prohibit. Other industrial countries are likewise experiencing similar waste-disposal problems.

For that reason, last October, I wrote President Nixon urging an international conference which would give exclusive attention to the problem of ocean dumping. In that letter, I suggested that the North Atlantic Treaty Organization's Committee on Challenges of Modern Society be considered as a prime mover in the problem of ocean dumping. I suggested that organization since it contains the principal industrial nations bordering the Atlantic Ocean. I still believe this to be desirable. I am also hopeful that this problem will be a principal item on the agenda of the United Nations Conference on the Human Environment scheduled for 1972.

While it well may be that the international aspect of this problem would lie outside the jurisdiction of this committee, I mention it only to indicate that the problem is not ours alone. We in Delaware are immediately concerned about the effects of ocean dumping on our shoreline; as citizens of the United States we must concern ourselves with all coastal areas as well as the detrimental effect that dumping has on marine life. And as inhabitants of this planet we must begin to work with other nations toward a solution of waste-disposal problems which will become increasingly critical in the years ahead.

Thank you.

Senator MUSKIE. Thank you very much, Senator Roth.

Our next witness already has had some buildup from Senator Case. I am delighted to welcome Congressman Sandman.

May I take this opportunity to congratulate him for the court action which he instituted in this field not so long ago with a successful result.

Representative Sandman.

STATEMENT OF HON. CHARLES W. SANDMAN, JR., A U.S. REPRESENTATIVE FROM THE STATE OF NEW JERSEY

Representative SANDMAN. Thank you, Senator Muskie.

I would like to compliment you and Senator Boggs and the rest of the members of the other body for having your hearing here, and I think this is probably the most appropriate place to have it because, as Senator Case has pointed out, this is the area where approximately 80 percent of the promiscuous dumping takes place in the waters in and around the State of Delaware and New Jersey.

I have a statement, Mr. Chairman, which I am going to file with your committee with some other information. Rather than read that statement I would rather narrate on those things in the statement that I think are perhaps the most important ones.

Our greatest problem here, as you well know, is one which has to do with jurisdiction which will enable the Federal courts to be of some adequate assistance to us in controlling the very hazardous position that we find ourselves in, and I am not going to go through the figures of destruction; they are well known. I again would like to support all of those statements made by the previous speakers and those that I know are going to follow on the point of severe destruction of marine life.

If we are going to do anything at all about this particular subject we must immediately enact some legislation that will put some teeth in the present law. I have been involved as a plaintiff in two court

actions in the U.S. District Court, one against a defunct chemical company plus the Commonwealth of Pennsylvania, and the other one against another chemical company that was going to dispose of highly toxic fluids in the ocean. The courts, although they were generous in taking our testimony and generous in granting the original restraining order—we still have some problem on how far we would be able to go if we had to go the full length of the hearing, which didn't happen in either case. We had a good result in both cases. The case against the Revere Chemical Co. and the Commonwealth of Pennsylvania was settled by an agreed court order. In that particular case the State of Pennsylvania was attempting to move 3½ million gallons of toxic fluid out into the ocean. There was some question on where they were going to deposit this fluid but the best information available to me had it about 30 miles off your coast right here at this point. They agreed to dispose of the fluid some 100 miles at sea where the water was 8,000 feet deep and where the marine biologist of New Jersey said the contour of the bottom would contain the fluid so that it would do the least amount of destruction, if it did any.

The second case, which was in the U.S. District Court only 2 weeks ago, had to do with the dumping of 70 tons of arsenic waste. I don't have to emphasize how deadly the word arsenic must be, but this was 70 tons that was going to be dumped out in the ocean, at no particular spot. In that particular action the chemical company again agreed not to dump into the ocean until there were some further meetings with the Federal agency where they would be able to prove it was harmless.

So again, by agreement, a serious lawsuit was settled but not with a test of any of the Federal laws.

As you well know, Mr. Chairman, there is a great deal of question as to what strength the U.S. District Court, or any court, has past the 3-mile limit. Therefore, it seems to me that the only way that we can possibly control any of these dangerous fluids, or the sludge problem that we talk about, is if we control it at the point of loading and, therefore, I will certainly support anybody's bill which is predicated upon a permit which deals with loading that particular kind of dangerous element.

I believe that every State in this Union owes an obligation to every other State not to permit any kind of transportation from that State where the disposition of such an element would be dangerous to the health and general welfare of the Nation, and this I think is the only thing we have under present law to hang our hats on to give any court jurisdiction.

The bill that I have introduced in the House, H.R. 1661, is almost typical of most of the other bills that pertain to a permit. Very briefly, Mr. Chairman, I think we have to have in this instance a bill that is going to be adopted soon—very soon—and a bill that will be strong with plenty of teeth in it. The bill that I have recommended to the House of Representatives requires that before any kind of substance, whether it be sludge or anything that is toxic, can be loaded in any of the ports of the United States, they must be loaded with the permission of a permit and the conditions precedent in receiving that permit are simply those things that have to do with the loading, the transporting, and most of all, the method and location of where it is going to be disposed of. This must be included in anybody's bill.

Now, if this is done, there should be a great deal of surveillance by both the U.S. Coast Guard and also the Environmental Protection Agency at the Federal level. Under this kind of a measure the U.S. District Court would have very strong and stiff enforcement powers.

I have recommended to the Congress that for the first violation—and the people guilty of the violation should be joint and several obligations, not only the owners of the transporting vessel but also the captain of the ship himself—the first violation should carry a very heavy penalty of \$50,000; the second violation should carry a penalty of \$100,000 or confiscation of the vessel, or both, whichever the court may decide to be the case.

The U.S. Coast Guard should have at least 4 hours' notice before any such ship would be allowed to leave a port so that at all times transportation of this kind of a substance would be under the strict surveillance of the parties that should be responsible for the disposition of it.

Dumping waste is only one of the many parts of the pollution problems that we have. It is the one that we are dealing with here today but at the same time we can hardly remedy this particular problem and then go home and think we have done a job, because we have many other problems in the pollution area.

I fly over this particular section at least twice a week and sometimes more than that, and every time I do I see a very large oil tanker about 5 miles off the coast of Delaware and strapped to each side of that tanker I see great big barges where this big tanker is unloading some of its weight so it can go farther up the river after it is lightened to some extent. The disturbing point is that on every occasion I see great big oil slicks and rings around each of those vessels. I am not at all convinced that this is being done in a prudent manner and I am certainly convinced that it is detrimental to the welfare and the environment in this particular area.

Again, I think we have to be mindful of the severe damage that can happen to the Delaware Valley, and I have a great deal of interest in the Delaware Valley that takes in the whole State of Delaware, the southern part of New Jersey, and some parts of Pennsylvania. If we are going to keep this environment the way we would like to have it, I think we have to forever resolve that this should not be a field for oil refineries and I think that the idea of bringing into this area the oil pipeline should be stymied before it gets here because this is a form of sludge that is going to be even worse than what we are talking about today.

Now, the House hearings on these bills will commence on the 5th of April and continue through the 7th of April, and, again, I would like to point out to the committee here that the most important thing that I believe any of us are going to be faced with is the one that has to do with time, even though we only recently learned about the tremendous amount of dumping that is happening off the coast of Delaware and New Jersey and all around the United States. It has been going on for years; its effect is highly detrimental. The only way that we can possibly curtail it is with a stronger law that will give the U.S. district courts the power to do something about it, which today they do not have, and to do an adequate job.

I thank you very much, Mr. Chairman, for this opportunity to speak. [Applause.]

(Congressman Sandman's prepared statement and supplementing materials follow:)

PREPARED STATEMENT OF HON. CHARLES W. SANDMAN, JR.

Representative SANDMAN. Thank you, Mr. Chairman and members of this distinguished committee. I will try to be brief.

I very much appreciate having the privilege of appearing before you here in Rehoboth Beach today on the subject of ocean pollution, a matter of particular vital concern to me and my constituents in the Second District of New Jersey.

On the opening day of this session of Congress, I submitted legislation in the House of Representatives to regulate and eventually eliminate the dumping of pollutants into the oceans. Since then, a number of other bills have been introduced in both the House and the Senate; the Administration has offered its own version; the legislatures of several states, including my own and the one in which we meet today, are enacting similar legislation adapted to state jurisdiction; and thankfully, the general public is aroused to the need for immediate action at all levels to end premeditated dumping of pollutants into the oceans.

I will not dwell on the scope of the problem, Mr. Chairman, for this has been dealt with most adequately in previous testimony before this Committee. Suffice it to say that it is undeniable that there is a trend toward using the oceans, the Gulf, Great Lakes and other waters of and around the nation as a dumping ground for all forms of waste, including dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid waste, explosives, chemical munitions and radioactive materials.

This trend continues as the result of two factors. First, insufficient effort and lack of strict state and federal laws to require land-based disposal facilities and sites. And secondly and most important, the trend continues simply because the United States currently has no jurisdiction to control ocean dumping beyond the three-mile territorial limits of the nation.

It is my opinion, from an extensive study and use of existing state and federal regulations on pollution in various court actions I have initiated, that we now have the legal tools to clean-up and regulate pollution within our territorial limits. The plain fact is, however, enforcement of existing laws has been too lax on the part of state and federal regulatory agencies. And in all fairness, the patchwork of law and court interpretations has left open to question the matter of which agency should be responsible for surveillance, enforcement and prosecution of existing law.

Therefore the legislation I seek enactment of this session has two basic points: First, it must create new jurisdiction for the regulation of pollution outside the territorial limits of the nation. And second, it must spell out which agencies are to be responsible for policy making, surveillance, enforcement and prosecution of violators of existing and new pollution control regulations, *both* inside and outside the nation's territorial limits.

The legislation I am the original author and sponsor of in the House (HR-1661, HR-5049-50) establishes controls where the nation *now* has jurisdiction: specifically at the loading docks and ports. I am pleased there seems to be general agreement on this approach in the legislation offered by the Administration, by our host here today, Senator Boggs and by the distinguished Senator from my state, Senator Case and others.

Further, it is agreed that the Administrator of the new Environmental Protection Agency should have the overall responsibility for administering all regulations; that the U.S. Coast Guard should provide surveillance and that violations shall be prosecuted in federal courts.

There are several points on which different language and intent exists from my study of the various legislation proposed. Mr. Chairman, I would briefly like to offer my opinion on some of these points.

First, as to when the proposed regulations should become effective, I oppose any delay. The permit requirements and the surveillance activities should not be postponed for six months, two years or six years as has been variously proposed. It is realistic and necessary for the provisions of new regulations to take effect immediately upon final passage as provided by law. This will provide no undue hardship for the polluters, for the Coast Guard or for the EPA because the pro-

visions of the law I am hopeful will result from these hearings and subsequent proceedings will be relatively simple to implement in the time between final Congressional action and the time the President signs the Act into law.

Next, I am pleased to support a provision added to the basic language of my bill by Senator Case in his bill now before this Subcommittee. His is a most worthy provision that the EPA be authorized to conduct and encourage research into means of recovering useful materials from wastes and disposal of wastes and to give financial and other assistance to appropriate public and private agencies to conduct such research and demonstration projects.

Further, Senator Case's proposal would provide funds for research and demonstration projects on establishing feasible and economical land-based disposal methods for wastes currently dumped into the oceans also has my support and I will indicate this to the appropriate Subcommittees of the House next month in their hearings on this subject.

Concerning my proposal that until adequate land-based disposal sites and facilities are established so that ocean dumping can be banned administratively by the Administrator of the EPA, no dumping should be allowed inside the Continental shelf, I am convinced this is realistic and feasible immediately.

This idea, Mr. Chairman, resulted from a stipulation I made in a U.S. District Court order I secured in January and it has since gained widespread support from fishermen, marine biologists, Members of Congress and others. In that permanent court order issued on January 20th in the case of "*Sandman v. Donald Lazarchack and Echo, Inc. and Revere Chemical, Inc.*", it was stipulated that because we lacked jurisdiction to prevent the dumping of some 4 million gallons of toxic chemicals, the defendants were ordered "to dump and otherwise dispose of the materials . . . into the Atlantic Ocean at least one hundred miles off the Coast of Cape May, New Jersey, the exact coordinate to be established by Dr. Lionel A. Walford, Director of the Sandy Hook Shellfish and Marine Laboratory located at Sandy Hook, N.J." The defendants had planned to dump the chemicals near shore before I secured a court restraint on January 14th.

My point in making reference to this court order, Mr. Chairman, is that it is realistic, I think from all available data, to say that if any dumping must continue in the interim until adequate land-based disposal or reclamation facilities are established, it is better for it to take place in deep waters beyond the Continental Shelf at specific locations established by authorities on marine ecology than to allow dumping to continue in shallow near shore waters that have been established by tradition without regard for the environmental consequences.

If this interim stipulation on dumping is included in the final version of our legislation, the immediate threat to the economy of our seashore resorts, the commercial and sportfishing industry and the general health and welfare of those who enjoy the oceans for recreation and as a source of food will be met.

I want to point out to this Subcommittee that it is my firm opinion, based on extensive and unpublicised studies in this area, that this "Continental Shelf provision" will not necessarily cause undue economic hardship on those affected by it: namely the various industrial and municipal polluters.

My good friend Henry P. Englebrecht, President of Ocean Environmental Engineering Co. of Middletown, N.J. has shown me and many others present here today that it is economically feasible to require a 100-mile dumping provision as an interim solution to this serious problem. His idea, quite simply, is that instead of continuing the current practice of using slow, low capacity barges to transport sewage sludge into near shore waters, fast, huge capacity ships could be used to transport this material some 100 miles offshore in approximately the same time and at approximately the same cost as the current practice. He advises that conversion of the vessels to this purpose would be feasible and that these operations could get underway within 90 days. Private financing is available and I am pleased to report negotiations are now underway with several municipalities and authorities that are the chief current sources of sludge that is dumped off the New Jersey coast, both off Sandy Hook and off Cape May near the site of this hearing.

Mr. Chairman, when the seriousness of the problem of sludge dumping and other ocean pollution became apparent to the general public, there were three major sources of sludge dumping from the Delaware River region: Philadelphia, Camden and Bridgeton, the latter being located in my Congressional District. Both Philadelphia and Camden are showing serious concern and giving honest attention to this problem. I am in close touch with Mayor Tate of Philadelphia, for example, and have his permission to report to you that he is doing everything possible to solve his city's disposal problems so sludge from Philadelphia can be placed elsewhere than in the ocean near here.

And it is with great satisfaction and pride that I can report that the City of Bridgeton, N.J. has discontinued ocean dumping altogether by allowing nurserymen to pick up dried and processed sludge for use as fertilizer. City officials advised me yesterday that they will receive bids on April 20th to rehabilitate Bridgeton's processing plant. Also it is heartening to hear that industries whose wastes go into the City's system are providing excellent cooperation by processing their wastes before they enter the system.

On the day I introduced my bill in Congress, Mr. Chairman, I wrote to the Governors, the attorneys general and the legislative leaders of all 50 states to urge that this legislation be enacted at their level, adjusted to state jurisdiction so that there will be double-control over ocean dumping. The replies and cooperation I have received are indeed heartening.

Because the extensive correspondence, research, court documents and other materials I have collected on the subject of ocean pollution should be of considerable value to this Subcommittee in its deliberations on appropriate legislation, I am providing copies of all relevant and potentially helpful information to you.

Included in this resource material are the letters from the Governors and other state level officials, copies of all legal papers from the two court actions I instituted this year to stop indiscriminate dumping, various articles and editorials from the media to show the widespread concern over this problem and support for the legislation, copies of all pending legislation on ocean dumping now before Congress and a library of the various statements on the subject that I have made.

I want to announce that the Subcommittees on Fisheries and Wildlife Conservation and Oceanography will hold joint open hearings on April 5, 6 and 7, 1971 at 10 a.m. each morning in Room 334 of the Longworth House Office Building in Washington. Some 30 separate bills on the subject of ocean pollution will be heard with appropriate testimony.

Mr. Chairman, I have appreciated this opportunity to speak on this issue and I commend the distinguished Members for your determination to clean up and protect forever our precious marine environment. Thank you.

[Excerpt from the Congressional Record Jan. 21, 1971]

LEGISLATION TO END INDISCRIMINATE OCEAN DUMPING

Hon. Charles W. Sandman of New Jersey, in the House of Representatives

Mr. SANDMAN. Mr. Speaker, it is altogether fitting, on this opening day of a new session of Congress, that we issue a loud and clear call to and on behalf of our countrymen to clean up and strive to protect forever our precious environment.

The wide variety of environmental bills introduced today by Members of the House indicates the growing national concern about pollution in all forms and is evidence of the determination of this body to meet this decade's most pressing problem.

I am particularly concerned with the increasing use of the oceans, gulf, Great Lakes, and other waters as the receptacle for chemicals, sewage, and garbage wastes along with other forms of pollution.

More than 70 percent of the earth's surface is covered by the oceans, using the term generally to include all major bodies of water. This vast area of water—some 140 million square miles—is critical in maintaining the world's environmental balance. The oceans affect our climate, the oxygen-carbon dioxide content of the atmosphere and they are of immense economic value to us as a source of minerals and food.

Pollutants are carried to the oceans through our waterways by vessels of all descriptions. They arrive by way of complex networks of pipelines. They are carried in the air only to filter or be washed down into the sea. And agricultural pollutants such as pesticides, animal wastes, and fertilizers also eventually reach the oceans.

There is accidental spillage of oil, sewage from vessels, and other forms of ocean pollution. However, the form of pollution that concerns us most is premeditated ocean dumping by industry and municipalities.

SCOPE OF THE PROBLEM

According to the President's Council on Environmental Quality, about 48 million tons of wastes were dumped at sea in 1968. These wastes included dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid waste, explosives, chemical munitions, radioactive, and miscellaneous materials.

There are now at least 250 known official and unofficial disposal sites off U.S. coasts. Informed sources say that number may well have doubled since most recent inventories. Half of the ocean dumping grounds are located off the Atlantic coast while the other half is divided almost evenly between the gulf and Pacific coasts.

That there is a clear trend toward increased use of the oceans as dumping grounds is undeniable. The volume of ocean dumpings is increasing rapidly. And this trend will undoubtedly accelerate as existing land-based disposal facilities and sites become more scarce and overburdened.

THE OBVIOUS DANGERS

I do not presume to be an authority on marine biology, though I am an avid student of this science. However, I do know that ocean pollution has already severely damaged the environment and will continue to do so at an increasing rate unless it is controlled now and eventually eliminated.

Pollution has already closed nearly one-fourth of the Nation's commercial shellfish beds; coastal swimming and other forms of recreation are already threatened—banned in some areas; thousands of square miles of ocean have been reduced to lifelessness by pollution and sport and commercial fishing is threatened.

There is no question that ocean dumping contributes to this serious problem and there is no question that something must be done now to stop it.

ALTERNATIVES TO OCEAN DUMPING

Naturally, to eliminate ocean dumping, there must be an alternative means and alternative places where waste materials can be disposed. And there are.

The mere fact that at present, less than 1 percent of our wastes are disposed of in the oceans, is proof that there are reasonable alternatives.

Let us face the truth. In this time of increasing consciousness by all Americans on the condition and appearance of our environment, the single main appeal of ocean dumping is that the United States currently has no jurisdiction to control it beyond the 3-mile limit. Those who advocate ocean dumping, for the most part, are those who would continue to sweep dirt under their carpet instead of applying their misguided ingenuity to use existing means of disposing of their wastes properly.

THE JURISDICTIONAL PROBLEM

Current regulatory activities and authorities are not sufficient to control ocean dumping. Though there are some controls over dumping within the 3-mile territorial sea, the most serious problem area is outside the jurisdictional limits of the States where there are no effective restraints or controls.

A number of bills on ocean dumping have been before the Members of the House. To my knowledge, none of them have offered an effective solution to the jurisdictional problem. Thus, no ocean dumping bill has been reported from the House Merchant Marine and Fisheries Committee.

The administration is on record as being opposed to ocean dumping as a long-range solution to the Nation's disposal problems. I am encouraged by reports that the President may support legislation aimed at curbing and eventually eliminating ocean pollution.

OCEAN DUMPING LEGISLATION

I am pleased to submit legislation today to control ocean dumping. This bill comes to grips with the jurisdictional problem without tampering with the distance of the limits of our jurisdictional boundaries.

My measure establishes controls where we now have jurisdiction: Specifically at the loading docks and ports. To load any vessel with waste material intended for

ocean dumping—a permit must first be obtained from the Administrator of the Environmental Protection Agency, which shall be charged with the responsibility of determining that each application for a permit considers the ecology of the marine environment.

This legislation also authorizes the Administrator to prohibit the loading, transporting or dumping of specific materials deemed damaging to the marine environment and it also empowers the Administrator to designate safe sites.

My legislation directs the Coast Guard to conduct surveillance and other enforcement activities and the bill provides stiff penalties for any violations. The text of my bill follows:

“H.R. —

“Be it enacted by the Senate and the House of Representatives of the United States of America in Congress assembled, That no owner or master of a vessel may load, or permit the loading of any waste on such vessel while such vessel is in any port of the United States, if such waste is to be discharged in ocean waters, unless such owner or master first—

“(1) obtains a permit from the Administrator of the Environmental Protection Agency (hereafter referred to in this Act as the ‘Administrator’) which authorizes the loading of such waste; and

“(2) notifies the Coast Guard of such loading as prescribed in Section 3.

“Sec. 2. (a) The Administrator shall issue to any owner or master of a vessel a permit authorizing the loading of waste on such vessel if the Administrator finds that the discharge of such waste in any ocean waters will not damage the ecology of the marine environment. In making any such finding, the Administrator shall consider the effect of such discharge on human health and welfare (including possible adverse effects on economic, recreational and aesthetic values) and on the marine ecosystem, taking into account the proposed location of such discharge and the concentration and volume of the waste to be discharged.

“(b) In no event shall any permit be issued for the discharge of any waste whatever between the continental shelf and the coast of the United States.

“(c) The Administrator shall have the authority to ban the loading, transporting and damaging to the marine environment or to human health and welfare

“(d) The Administrator shall have the authority to designate ocean dumping sites.

“(e) Each permit issued under subsection (a) shall specify—

“(1) the amount and type of waste authorized to be loaded and discharged;

“(2) the exact coordinates of the location at which such discharge is permitted and a statement of the route to that location;

“(3) such provisions as the Administrator deems necessary to insure that such waste will be transported to the discharge site without accidental spillage or leakage; and

“(4) such other provisions as the Administrator deems necessary to carry out the purposes of this Act.

“Sec. 3. (a) Any owner or master of a vessel who is issued a permit under section 2 must notify the Coast Guard and the Army Corps of Engineers of the exact location where the waste covered by such permit is to be discharged. Such notification must be given to the Coast Guard and the Army Corps of Engineers in such manner as the Administrator of the department in which the Coast Guard is operating shall prescribe and not later than four hours before the departure of the vessel.

“(b) The Administrator of the department in which the Coast Guard is operating shall conduct surveillance and other appropriate enforcement activity to prevent violations of this Act.

“Sec. 4. (a) Any owner or master of a vessel who violates the first section of this Act or who violates any provision of a permit issued under section 2 of this Act shall be liable to a civil penalty of not more than \$50,000 for the first violation, and not more than \$100,000 for each subsequent violation. No penalty shall be assessed until the person charged shall have been given notice and an opportunity for a public hearing on such charge. Upon failure of an offending party to pay the penalty, the Administrator may request the Attorney General to commence an action in the appropriate district court of the United States for such relief as may be appropriate.

“(b) A vessel, other than a vessel owned or bargeboat chartered by the United States, or other property used in a violation shall be liable in rem for any civil penalty assessed under this section and may be proceeded against in any district court of the United States having jurisdiction thereof.

“Sec. 5. As used in this Act—

"(1) The term 'discharge' means to place, release, discharge, or by any means whatsoever to dispose, of waste in ocean waters.

"(2) The term 'master' includes any person acting in the capacity of a master.

"(3) The term 'ocean waters' means any estuarine area, coastal waters, Great Lakes, territorial waters, and the high seas adjacent to the territorial waters.

"(4) The term 'owner' includes any private individual or corporate owner and any public owner, whether a department, agency, or instrumentality of a State or a political subdivision thereof, of an interstate governmental entity, or of the Federal Government.

"(5) The term 'United States' means the States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, and American Samoa.

"(6) The term 'vessel' includes any vessel scow, or boat, whether or not documented under the laws of the United States, capable of being used to transport waste in ocean waters.

"(7) The term 'waste' means matter of any kind or description, including, but not limited to, dredge spoil, spoil waste, garbage, sewage sludge, munitions, chemical, biological and radiological warfare agents, radioactive materials, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial wastes.

"SEC. 6. This Act shall take effect immediately upon final passage as provided by law.

"SEC. 7. On and after the effective date of this Act, any license, permit, or authorization issued by any officer or employee of the United States under the authority of any other provision of law shall be terminated and be of no effect whatsoever to the extent that such license, permit, or authorization authorizes any activity to which this Act applies."

I am inviting all Members of the House to join me in sponsoring this legislation.

I am also calling upon the Governors, the attorneys general, and the legislatures of all of the States bordering on the Atlantic Ocean, the Pacific Ocean, the Gulf of Mexico, and all tributaries leading thereto to enact this legislation adjusted to their jurisdiction as a matter of State law so that there will be a heavy surveillance over the loading, transporting, and dumping of any kind of polluting material that may pollute the rivers, bays and harbors of the United States and all of the waters surrounding the Nation.

[News Release From: U.S. Rep. Charles W. Sandman, Jr., Second District, New Jersey]

SANDMAN BLOCKS OCEAN DUMPING OF ARSENIC COMPOUND

No more arsenic sludge will be dumped in the Atlantic Ocean by Pennsylvania Chemical firms as a result of action by U.S. Rep. Charles W. Sandman, Jr. (2nd-NJ).

The Congressman hauled the firms into U.S. District Court in Philadelphia Monday (March 15th) and secured commitment that dumping of the potentially lethal material would cease immediately and not be resumed without a week's notice in advance to the court, Sandman and others.

Meanwhile, attorneys for the firms: Whitmoyer Laboratories, Inc. of Meyers-town, Pa. and its parent firm, Rohm & Haas, Inc. of Philadelphia are seeking to prove that their long standing practice of ocean dumping is "harmless".

The arsenic compound is a by-product of a feed manufacturing process of the Whitmoyer firm. Apparently, though details remain sketchy, the wastes are contained in 55-gallon drums which, for the last two years at least, have been regularly dumped at sea.

On Thursday, (March 11th) Sandman learned of the dumping from a newspaper exposé and on Friday, (March 12th) took the matter to court. The news accounts stated that some 70 tons of the arsenic compound would be loaded for ocean dumping Saturday (March 13th).

Fearing that continued dumping would "upset the ecological balance of the Atlantic Ocean" and cause "irreparable harm," the Congressman filed a complaint and request for a temporary restraining order in U.S. District Court in Philadelphia. All agencies, individuals and firms involved were notified in advance.

Late Friday (March 12th) U.S. District Judge Donald VanArsdalen granted the temporary restraint requested by Sandman. Simultaneously, the firms announced they would "voluntarily suspend" their dumping until they could demonstrate the practice is "harmless" as claimed.

At a hearing on the restraint Monday morning (March 15th), three parties applied to the court to intervene on behalf of the plaintiff, namely Congressman Sandman. They were Ralph Nader, Natural Resources Defense Council, Inc. and Reuben B. Robertson, III.

Before Judge VanAnrsdalen at the request of the firms, Sandman agreed to allow the restraint to be lifted on the condition that the dumping would cease and that if the firms intend to resume dumping, they agree to give a week's notice to the court, the Congressman and the other plaintiffs.

Additionally, the firms agreed to meet in Washington, D.C. with Sandman, the other plaintiffs, and officials of President Nixon's Council on Environmental Quality and the federal Environmental Protection Agency.

Officers and attorneys for both Whitmoyer Labs. and Rohm & Haas, ninth largest chemical firm in the world, persist in their opinion that their dumping activities are not harmful to the environment.

Sandman is demanding proof and added that until he receives it, if the firms notify him they intend to resume dumping, the Congressman will ask the court to reinstate the restraining order.

If the firms fail to notify the Congressman before they resume dumping, Sandman said he will ask that they be held in contempt of court.

Besides Whitmoyer Labs and Rohm & Haas, other defendants in Sandman's civil action are the Norton Lilly Co., booking agency for the ships that dump the material and Donald Lazarchack of the Division of Waste Disposal of the Health Department of the Commonwealth of Pennsylvania.

Sandman claims the Waste Disposal agency should have known about and moved to stop the dumping operations on the grounds that each state should protect the health and general welfare of citizens of other states by regulating the loading, transporting and dumping of such wastes.

In January, Sandman secured similar restraints and a permanent court order to regulate dumping of some 4 million gallons of toxic chemicals from a defunct Doylestown, Pa. firm.

Additionally, Congressman Sandman is author and prime sponsor of proposed legislation to regulate and eventually eliminate ocean dumping of wastes. Deliberations on the bill are underway in both Houses of Congress and several state legislatures are moving to enact the measure as a matter of state law, adjusted to their jurisdictions.

Congressman Sandman has predicted enactment of ocean dumping legislation during this session of Congress. Such action has the active support of the Nixon Administration.

[Your Congressman Charles W. Sandman, Jr., Reports to You]

(Second District, New Jersey—Atlantic, Cape May, Cumberland and Salem Counties)
February 17, 1971

A BEGINNING OF THE END OF OCEAN POLLUTION

The most pressing environmental problem in South Jersey—water pollution—has become the focus of national attention and concern and is now a priority target for action by this new 92nd Congress.

Of the many sources of water pollution, the one that concerns us most is premeditated ocean dumping by industry and governments. As your Congressman, I have taken decisive and original action on two fronts: by securing a permanent federal court order to regulate one source of ocean pollution and by introducing legislation in Congress to regulate and eventually eliminate all forms of ocean pollution. Both of these actions have been widely publicized and supported throughout the nation as being constructive in the overall effort to restore and forever protect our precious environment.

SCOPE OF THE PROBLEM

According to the President's Council on Environmental Quality, about 48 million tons of wastes were dumped at sea in 1968. This figure has increased rapidly in the last two years and it is undeniable that there is a trend toward using the oceans, gulf, Great Lakes and other waters of the nation as a dumping ground for all forms of waste, including dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid waste, explosives, chemical munitions, and radioactive materials.

This trend continues as the result of two factors. First, insufficient effort and lack of strict state and federal laws to require land-based disposal facilities and sites. *And most important, the trend continues simply because the United States currently has no jurisdiction to control ocean dumping beyond the three-mile territorial limits of the nation.*

LACK OF JURISDICTION

The simple fact is that under existing law, there are no restraints whatsoever against ocean dumping beyond the three mile limit which is where the main problem exists off the South Jersey coast.

In early January, the plan of the Division of Waste Disposal of the Commonwealth of Pennsylvania to dump some 3½ million gallons of toxic industrial wastes off Cape May came to my attention. Seeing this as a serious potential threat to marine life, the fishing industry, the seashore resorts and to the health of residents and visitors of the resort area, I immediately investigated all avenues of stopping the proposed dumping.

U.S. DISTRICT COURT DECISION

Represented by my good friend Roger Soens, a member of the Philadelphia Bar, I appeared before the U.S. District Court in Philadelphia on January 14th to seek an injunction against the dumping. The Judge granted a temporary 10-day restraining order against Pennsylvania to allow time for arguments to be prepared for a hearing on my request for a permanent court order.

Due to the lack of jurisdiction of the courts to control ocean dumping beyond the three mile limit, it became apparent that it was impossible that the court could have sustained my request that the dumping be prohibited altogether. As a result, I decided that if I couldn't prevent Pennsylvania from dumping, at least I could ask the court to instruct them exactly where, how and when to dump the chemicals so that the least possible damage would be done to the marine environment. This is exactly what happened.

On January 20, the U.S. District Court issued a permanent court order containing the agreement of Pennsylvania to do three things: (1) to dump the chemicals at least 100 miles off the coast in a specific place designated by New Jersey's chief Marine Biologist. (2) to notify the Coast Guard and the Army Corps of Engineers at least four hours before each barge leaves port so that strict surveillance of the operation was possible, and (3) to give me personally at least ten days written notice in advance of any similar dumping project in the future so I can seek similar restraints from the court.

The court's ruling is highly significant since it sets a precedent for the entire country. This is the first time any ocean dumping was regulated by a court order.

OCEAN DUMPING ACT OF 1971

On the opening day of the 92nd Congress, one of the first bills introduced was HR-1661, my legislation "to regulate and eventually eliminate the disposal of wastes in territorial and international waters." It is the first bill of its kind and is considered to be the most far-reaching of the wide variety of pollution prevention bills on the subject yet introduced.

My measure establishes controls where we now have jurisdiction: specifically at the loading docks and ports. To load any vessel with waste material intended for ocean dumping, a permit must first be obtained from the Administrator of the Environmental Protection Agency, which is charged with the responsibility of determining that each application for a permit considers the ecology of the marine environment.

The legislation authorizes the Administrator to ban the dumping of certain wastes and it directs the Coast Guard to conduct surveillance and other enforcement activities. Stiff penalties for violations are provided. As soon as adequate land-based disposal facilities and sites are ready, the Administrator will simply declare that there shall be no further dumping of wastes in the ocean whatsoever.

NATIONWIDE SUPPORT

Some 50 of my colleagues in the House, representing two dozen states, have volunteered to co-sponsor HR-1661 with me. Overwhelming support for ocean dumping legislation this year is in evidence in the Merchant Marine and Fisheries Committee where the bill is now being considered. And of the entire membership of the House, I expect near unanimous support when the measure reaches the floor.

I am gratified and honored that President Nixon has mobilized the Administration behind these efforts to combat coastal pollution. Just last week, he sent his "Marine Protection Act of 1971" to Congress for consideration. It is identical in concept and purpose and very similar in language to my own legislation.

Additionally, I have called on the Governors, the attorneys general, and the legislatures of all the 50 states to enact this legislation adjusted to their jurisdiction as a matter of state law. The responses I have received from the states has been highly encouraging. In New Jersey, for example, the legislation is now before the Assembly and favorable support has been indicated by the Governor and Attorney General for its enactment.

This crusade for cleaner water has now gained the momentum it deserves. I will continue to press for prompt and positive action at the federal level and encourage efforts at the state and local levels until we finally obtain the necessary legal tools with which to protect the environment.

[News release from office of Congressman Charles W. Sandman, Jr., second district, New Jersey]

A "beginning of the end" of ocean pollution is the result of a precedent-setting court action spearheaded this week by Congressman Charles W. Sandman, Jr. (2nd-N.J.)

Wednesday morning (Jan. 19), U.S. District Judge Harold Wood issued a permanent court order to control the dumping of industrial wastes from Pennsylvania. The order replaces a temporary restraining order obtained last Thursday by Sandman, acting individually and as an elected representative of the people of South Jersey.

Specifically, Sandman's court order permits the Commonwealth of Pennsylvania to complete its current project of disposing of some 3½ million gallons of toxic industrial waste on three conditions:

That the material be dumped not less than 100 miles off the coast of the United States at a specific point to be designated by the director of the Sandy Hook, N.J. Marine Laboratory. The Director, Dr. Lionel A. Walford, will select an area of ocean where the dumping will least harm marine life and where it will minimize any possible threat to the resort economy and health of the people of South Jersey.

That no less than four hours before any barge containing the waste can leave port in Philadelphia, the contractor must notify the Commander of the U.S. Coast Guard Base at Cape May and the Army Corps of Engineers in Philadelphia. Both agencies are to provide strict surveillance of the dumping to insure that the material is dumped in accordance with Sandman's specifications.

That is at anytime in the future the Commonwealth of Pennsylvania desires to dump anything in the ocean anywhere, it must first give ten days written notice to Congressman Sandman at his Cape May City office.

Avalon attorney, Roger J. Soens, who practices in Philadelphia, represented the Congressman in Federal Court in obtaining the restraining order last week and the court order Wednesday.

The Commonwealth, represented by its Director for Environmental Protection Services, Alvin H. Tucker, Jr., and its Director of the Division of Industrial Waste, Donald A. Lazarchik, agreed to the three conditions established by Sandman.

"Naturally, I would have preferred to have been able to obtain a total ban against ocean dumping of all kinds," the Congressman said Wednesday before flying to Washington to be sworn-in for this 92nd Congressional term. "But this was only the first round of our overall battle."

Unfortunately, he said, Pennsylvania's contractors had already moved about 700,000 gallons of the chemicals to the wharf in Philadelphia and were ready to load the first of seven barges when I obtained the restraining order last week.

"Any great delay in solving this matter—even the ten days of the temporary restraint—could have caused a serious health and pollution problem in the upper regions of the Delaware River," Sandman explained. "If this waste leaked, it could cause many times more damage to the River and Bay than the Ocean dumping proposal."

The Commonwealth has budgeted nearly \$400,000 to get rid of the chemical wastes left by a defunct plating plant in Revere, Bucks County, Pennsylvania.

Sandman's success in forcing the dumping to take place a full 100 miles off the coast is expected to cost Pennsylvania an additional \$15,000, according to the state officials.

"I consider this a major victory for all of us who comprise the forces for clean water," Sandman said Wednesday. "The precedent established by this court action is new ammunition in our growing arsenal against the ocean polluters."

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ALASKA

STATE OF ALASKA,
OFFICE OF THE GOVERNOR,
Juneau, February 9, 1971.

HON. CHARLES W. SANDMAN, JR.,
*Member of Congress, U.S. House of Representatives,
Washington, D.C.*

DEAR MR. SANDMAN: Thank you for your letter of January 26 and the copy of Congressional Record including the remarks you made upon introducing the legislation to control the dumping of wastes in the territorial waters of the United States and in international waters.

I have referred this material to the appropriate departments of Alaska State Government for review.

Kindest regards.

Sincerely,

WILLIAM A. EGAN,
Governor.

STATE OF ALASKA,
DEPARTMENT OF LAW,
Juneau, March 18, 1971.

HON. CHARLES W. SANDMAN, JR.,
*Member of Congress, Cannon Building,
Washington, D.C.*

DEAR REPRESENTATIVE SANDMAN: Thank you for your recent letter calling attention to your legislation relating to the control of dumping of waste in the territorial waters of the United States. As you may know, we in Alaska are particularly concerned with matters relating to environmental quality. As we proceed in our review of the Alaska laws relating to environmental protection, you may be assured that your proposal will be kept in mind.

Thank you for your consideration and interest in Alaska.

Very truly yours,

JOHN E. HAVELOCK,
Attorney General.
By KENNETH FRANK,
Assistant Attorney General.

ARKANSAS

STATE OF ARKANSAS,
OFFICE OF THE GOVERNOR,
Little Rock, February 2, 1971.

CONGRESSMAN CHARLES W. SANDMAN, JR.,
*Congress of the United States,
House of Representatives, Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Your letter of January 26 addressed to Governor Dale Bumpers has been referred to me as the Governor's Coordinator for his Legislative Program.

The Governor has asked that I study your proposal and make a recommendation to him regarding the possibility of adopting this proposal as an administration measure so that it may be proposed to the Arkansas General Assembly.

The Governor asked that I refer this information to you.

Sincerely,

CHARLES D. MATTHEWS.

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CALIFORNIA

STATE OF CALIFORNIA,
GOVERNOR'S OFFICE,
Sacramento, February 19, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
House of Representatives, Longworth Office Building,
Washington, D.C.

MY DEAR CONGRESSMAN: Thank you for sending me a reprint of your legislation to control the indiscriminate dumping of wastes into our oceans. I share your concern and agree that we must take steps to control this practice.

The State of California is moving rapidly to end the indiscriminate dumping of waste and toxic materials into the ocean. In January our State Water Resources Control Board held a preliminary hearing on the subject of ocean dumping and is now actively reviewing the subject preparatory to the adoption of state policy within the next few months. The California Regional Water Quality Control Board, San Francisco Bay Region, recently adopted a resolution prohibiting the dumping of waste materials into the ocean waters within its region.

We are committed to the struggle for clean water in California and I can assure you that this administration will take the necessary steps to control indiscriminate dumping of wastes into the ocean.

Federal legislation such as you have proposed may be of significant help to us in controlling those wastes which are dumped into offshore waters over which the state has no control. I would hope, however, that it would supplement and not supplant state efforts to control these problems.

Sincerely,

RONALD REAGAN,
Governor.

STATE OF CALIFORNIA,
LIEUTENANT GOVERNOR'S OFFICE,
Sacramento, March 10, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
Member of Congress,
Washington, D.C.

DEAR CONGRESSMAN SANDMAN: Thank you for your letter concerning legislation to control and eventually eliminate indiscriminate dumping of wastes in the territorial water of the United States and in international waters.

I am deeply concerned with the quality of our environment. Not only have I supported federal and state action on these problems, but have also urged that large industries assume a share of the responsibility. I have been actively supporting the study of an underwater aqueduct which would be used to pipe sewage and industrial effluent to master treatment plants at the mouths of rivers where it would be restored to an acceptable state of purity.

Thank you once again for your letter and the text of your legislation.

Sincerely,

ED REINECKE.

ASSEMBLY, CALIFORNIA LEGISLATURE,
February 18, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
Member of Congress,
House of Representatives, Washington, D.C.

DEAR MR. SANDMAN: Thank you for calling to my attention that you have introduced legislation to end the indiscriminate dumping into our oceans. I have taken the liberty of forwarding your information to the Assembly Committee on Natural Resources.

I was pleased to be apprised of your action in this regard.

Sincerely,

BOB MORETTI,
Speaker of the Assembly.

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DELAWARE

STATE OF DELAWARE,
DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL,
Dover, March 3, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*House of Representatives,
Cannon Building, Washington, D.C.*

DEAR MR. SANDMAN: Governor Russell W. Peterson has asked that I reply to your letter of 26 January, pertaining to your proposed legislation on eliminating ocean dumping.

We are in full agreement that a system needs to be developed to manage loading, moving, and dumping "of any form of waste material that may pollute the rivers and bays of the United States and all of the international waters surrounding the Nation."

Certainly, an integral part of ocean dumping should be strict and comprehensive surveillance. We in Delaware are also developing an Ecological Warning System to provide us a continuous source of base line information. It is expected that the system for surveillance will be developed and placed in operation in 1971. We would be pleased to exchange with you or members of your staff or others in New Jersey this particular undertaking.

We were pleased to receive your letter. I am especially appreciative of being given the opportunity to respond.

Sincerely,

AUSTIN N. HELLER,
Secretary.

FLORIDA

STATE OF FLORIDA,
February 16, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
House of Representatives, Washington, D.C.*

DEAR CHARLIE: Thank you for your letter of January 26 concerning ocean dumping. Florida is attempting to control this problem and has begun by passing an act which requires at least secondary treatment for all ocean outfalls and disposal wells for sewage disposal by January 3, 1974. A copy of this act is enclosed.

The recommendations contained in *Ocean Dumping: A National Policy*, by the President's Council on Environmental Quality, are an excellent beginning in seeking solutions to this problem and I appreciate your letting me know about your bill. With kind regards, I remain

Sincerely,

REUBIN O'D. ASKEW,
Governor.

GEORGIA

EXECUTIVE DEPARTMENT,
Atlanta, January 29, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
House of Representatives, Washington, D.C.*

DEAR CHARLIE: Thank you very much for your letter of January 26 relative to legislation designed to eliminate the dumping of wastes in the territorial waters. I assure you that I wholeheartedly concur with this goal.

I am sending a copy of your letter to the Honorable Rock Howard, Director of the Georgia Water Quality Control Board, with the request that he look into the matter.

With kindest regards and best wishes, I am

Sincerely,

JIMMY CARTER.

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HOUSE OF REPRESENTATIVES,
Atlanta, January 29, 1971.

HON. CHARLES W. SANDMAN, JR.,
*Congress of the United States,
House of Representatives, Washington, D.C.*

DEAR CHARLIE: Thank you for your letter of January 27 and copy of your statements to the House of Representatives on January 21.

I am referring this matter to Honorable Virgil T. Smith, Chairman of our House Health & Ecology Committee.

With kindest regards

Sincerely yours,

GEO. L. SMITH II.

THE DEPARTMENT OF LAW,
STATE OF GEORGIA,
Atlanta, February 2, 1971.

HON. CHARLES W. SANDMAN, JR.,
*Representative, 2d District, New Jersey,
Congress of the United States, Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: This will acknowledge receipt of your letter of January 27, 1971, and the attached copy of the Congressional Record. Thank you for the same.

I have this date forwarded a copy of your letter and attachment to the appropriate legislative committees. As the State of Georgia has recently been involved in a controversy over the dumping of waste in the territorial waters of the United States, I am sure that your proposed legislation will be of great interest to the members of the committees.

Sincerely yours,

ARTHUR K. BOLTON,
Attorney General.

HAWAII

EXECUTIVE CHAMBERS,
Honolulu, February 19, 1971.

HON. CHARLES W. SANDMAN, JR.,
*Member of Congress, House of Representatives,
Washington, D.C.*

DEAR CHARLIE: Thank you for your letter of January 26, 1971.

The Hawaii Waste Management Act of 1970 authorized the Department of Health to adopt rules and regulations for the control of the disposal of solid waste.

We are very concerned with the quality of our waters and will do everything within our authority to preserve it for the people and visitors of our State.

We will most certainly consider provisions of your bill and plan on enacting state legislations which would be consistent with applicable federal laws.

Warmest personal regards. May the Almighty be with you and yours always.

Sincerely,

JOHN A. BURNS.

IDAHO

STATE OF IDAHO,
OFFICE OF THE GOVERNOR,
Boise, February 1, 1971.

HON. CHARLES W. SANDMAN, JR.,
*U.S. House of Representatives,
Washington, D.C.*

DEAR CHARLIE: Thank you for your letter of January 26, enclosing your remarks concerning the problem of ocean pollution and your proposed bill to regulate this matter. We have been quite concerned about the matter of water pollution and will study your proposed bill to consider its possible adaptation at the state level.

Best of luck to you in your endeavors to secure the legislation at the national level.

Sincerely,

CECIL D. ANDRUS,
Governor.

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ILLINOIS

STATE OF ILLINOIS,
OFFICE OF THE GOVERNOR,
Springfield, February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*House of Representatives, Cannon Building,
Washington, D.C.*

DEAR CHARLIE: I appreciate your having forwarded to me your comments and proposed legislation on the problem of dumping wastes in our country's territorial waters. I have referred your correspondence to the Institute on Environmental Quality with the request that they review your proposal with the view to recommending legislation for enactment in our state.

Yours very truly,

RICHARD B. OGILVIE,
Governor.

INDIANA

STATE OF INDIANA,
OFFICE OF THE GOVERNOR,
Indianapolis, February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
House of Representatives, Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Thank you for your letter of January 26, 1971, in which you urge legislation to control dumping of wastes in the territorial waters of the United States. I have sent copies of your letter to the State Department of Natural Resources and the State Stream Pollution Control Board for their evaluation and suggestions.

I appreciate very much your writing and will be pleased to assist where possible.

Sincerely,

EDGAR D. WHITCOMB,
Governor.

IOWA

STATE OF IOWA,
OFFICE OF THE SPEAKER,
Des Moines, February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*U.S. Congressman,
Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Thank you very much for your recent communication and we will send your comments to our committee on Environmental Preservation for their consideration.

Sincerely,

WILLIAM H. HARBOR,
Speaker of the House.

KANSAS

STATE OF KANSAS,
*Office of the Governor,
Topeka, February 16, 1971.*

HON. CHARLES W. SANDMAN, Jr.,
*U.S. Representative,
Washington, D.C.*

DEAR CHARLIE: Thank you for sending me information concerning your proposed legislation to control dumping of wastes in territorial waters of the United States and in international waters.

Your proposals will receive every consideration.

With every good wish.

Yours sincerely,

ROBERT DOCKING,
Governor of Kansas.

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MAINE

STATE OF MAINE,
OFFICE OF THE GOVERNOR,
Augusta, February 26, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*U.S. House of Representatives,
Washington, D.C.*

DEAR REPRESENTATIVE SANDMAN: Thank you for your letter urging Maine to adopt legislation controlling and eliminating dumping of wastes into our waters. The State has already adopted legislation which will phase out the dumping of industrial wastes beyond tolerable limits into our waterways. In addition, Maine has oil handling control legislation which is generally regarded as being the strictest in the Nation.

I am enclosing a copy of the Oil Handling legislation in case it might be of interest to your legislative assistant.

Sincerely,

KENNETH M. CURTIS,
Governor.

MARYLAND

STATE OF MARYLAND,
EXECUTIVE DEPARTMENT,
Annapolis, February 4, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*House of Representatives,
Washington, D.C.*

DEAR CHARLIE: Thank you for your recent letter and the attached material concerning dumping of wastes. I certainly agree that this is a serious problem and I have referred the matter to my legislative staff for analysis.

I appreciate your keeping me informed on this subject.

With kindest regards.

Sincerely,

MARVIN MANDEL,
Governor.

HOUSE OF DELEGATES,
Annapolis, Md., February 22, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*U.S. Congressman,
Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Thank you for your letter of January 27th, enclosing a copy of your legislation pertaining to pollution.

I am referring this information to the Committee on Environmental Matters for their perusal should they desire to introduce similar legislation.

Very truly yours,

THOMAS HUNTER LOWE.

THE ATTORNEY GENERAL,
Baltimore, Md., February 23, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Thank you for your letter of January 27th and its enclosed copy of proposed ocean dumping legislation.

We have reviewed this legislation and support the principle of creating a permit system to regulate offshore dumping. As you have pointed out, both the public and private sectors of our society have increased the volume of waste disposal into the high seas. Should the trend be allowed to continue, some scientists believe that the level of pollution in the oceans will reach the point where the seas will no longer have the capacity to accept and ameliorate the vast amounts of waste which are discharged into them.

In recent years various examples of ocean dumping have been brought to the public's attention, but the true extent of offshore waste disposal remains uncer-

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tain. Regulation at the federal level appears to be the solution, especially with the provision contained in Section 2b of your Bill prohibiting the discharge of any waste into the waters between the continental shelf and the coast of the United States.

The State of Maryland is fortunate in possessing one of the world's great spawning grounds for shellfish, crabs, and certain species of fish. We are constantly mindful of the necessity for maintaining a high level of water quality, not only in the Chesapeake Bay and its tributaries, but in all the waters of our State. The federal water quality standards for instream parameters and for effluent standards have been adopted, amplified, and forcefully implemented by the Maryland Department of Natural Resources. The 1970 Maryland Legislature adopted a new and strict pollution abatement law, which became effective in July, 1970. As a consequence of our present laws and the enforcement procedures we have adopted, this State will not tolerate the dumping of any waste material which would have a deleterious effect on the waters of this State and the life contained therein.

It is our opinion, as noted above, that federal regulation as to offshore waters is the best way to combat the problem, between the continental shelf and the United States. The enactment of your bill can have no effect other than to significantly benefit the interests of this State.

Sincerely yours,

FRANCIS B. BURCH,
Attorney General of Maryland.

MASSACHUSETTS

THE COMMONWEALTH OF MASSACHUSETTS,
DEPARTMENT OF THE ATTORNEY GENERAL,
Boston, February 22, 1971.

Hon. CHARLES W. SANDMAN, Jr.
Washington, D.C.

DEAR CONGRESSMAN: Thank you for your recent letter enclosing an excerpt from the Congressional Record which sets forth your statement of views and proposed legislation relative to the control and eventual elimination of the indiscriminate dumping of wastes in the territorial waters of the United States and in international waters.

This is a subject which is of course of great concern to Massachusetts and my office has already been involved in at least one major situation involving such dumping.

I am forwarding your letter and the bill you have filed to the Chief of my Environmental Protection Division for study and for consideration as to the modification of your bill for filing with the Massachusetts General Court.

Thank you for bringing to my attention this important material.

Very truly yours,

ROBERT H. QUINN,
Attorney General.

MICHIGAN

STATE OF MICHIGAN,
DEPARTMENT OF ATTORNEY GENERAL,
Lansing, February 23, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR MR. SANDMAN: This will acknowledge receipt of legislation introduced by you to halt indiscriminate dumping of wastes in the territorial waters of the United States and international waters.

Please be advised that the state of Michigan has several statutes which control the problem of such dumping. We have Act 291, Public Acts of 1965, as amended, which is currently being revised and Act 167, Public Acts of 1970, which controls the dumping of wastes from boats and ships. In addition, we control activities of liquid waste haulers (Act 136, P.A. 1969). Also, we have a very effective pollution act (Act 245, P.A. 1929, as amended).

1946

We appreciate that the problem of dumping is a serious one. This has been our position for many years and this state has had a very active program of surveillance and regulation, in the filling and dredging area involving both inland and Great Lakes waters.

We hope that other states will see fit to become active in this area and we believe your efforts in this respect are very commendable.

Very truly yours,

FRANK J. KELLEY,
Attorney General.

MINNESOTA

STATE OF MINNESOTA,
OFFICE OF THE GOVERNOR,
St. Paul, February 3, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*U.S. House of Representatives,
Washington, D.C.*

DEAR CHARLIE: Thanks for sending me a copy of the legislation which you introduced to control the dumping of waste into the waters of the United States. As you know, the state of Minnesota is facing a similar problem, particularly with regard to Lake Superior. In the next few weeks, I will be developing a legislative program to protect our environment. I will certainly give your legislation my most serious attention as I develop this program.

Sincerely,

WENDELL R. ANDERSON.

MISSISSIPPI

STATE OF MISSISSIPPI,
EXECUTIVE DEPARTMENT,
Jackson, February 3, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Cannon Building,
Washington, D.C.*

DEAR CHARLIE: Your remarks and proposed legislation on ocean dumping certainly attack a very serious problem.

I received your letter and remarks four days after the deadline for introductions of bills in this session of the Legislature. However, we presently have some legislation that permits fair control over this problem. I wish you luck in your efforts.

Sincerely,

JOHN BELL WILLIAMS,
Governor.

MISSOURI

EXECUTIVE OFFICE,
Jefferson City, Mo., February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Member of Congress
Washington, D.C.*

DEAR CHARLIE: Many thanks for your letter of January 26 with regard to legislation you have introduced in the 92nd Congress to control and eventually eliminate indiscriminate dumping of wastes.

I applaud your efforts and assure you of my genuine interest and cooperation at the state level.

Sincerely yours,

WARREN E. HEARNES.

1947

MONTANA

STATE OF MONTANA,
OFFICE OF THE ATTORNEY GENERAL,
Helena, March 11, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: This is in reply to your letter concerning legislation which you introduced in the House of Representatives concerning the above matter. I want to apologize for my delay in answering your letter; however, the state legislature has been in session and has taken a great deal of my time.

I appreciate the information contained in your letter and the attachment thereto. I too am vitally interested in environmental problems. For your information, the present legislature has adopted new legislation strengthening the water pollution control act in the state of Montana.

If I can furnish any additional information or be of further assistance to you, please advise.

Very truly yours,

ROBERT L. WOODAHL,
Attorney General.

NEW HAMPSHIRE

STATE OF NEW HAMPSHIRE,
Concord, February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Congress of the United States,
Washington, D.C.*

DEAR CHARLIE: Thank you for the remarks which I read with great interest. The subject of ocean dumping is of great interest to those of us in New Hampshire.

Even though we have only a relatively short coastline, it is tremendously important and of great economic benefit to the State of New Hampshire.

If I can be of assistance to you in any way, please do not hesitate to call upon me.

Sincerely,

WALTER PETERSON,
Governor.

NEW JERSEY

STATE OF NEW JERSEY,
OFFICE OF THE GOVERNOR,
Trenton, February 8, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Member of Congress,
Washington, D.C.*

DEAR CHARLIE: Thank you for your January 26, 1971 letter regarding the serious problem of dumping of waste in the territorial waters of the United States and in international waters.

As you are probably aware, on many occasions, I have made public statements, and I have written several times to the Army Corps of Engineers urging the Corps to impose as a condition of ocean dumping that waste be taken beyond the continental shelf until such time as ocean dumping methods can be phased out altogether.

You may be interested in the attached copy of a January 25, 1971 letter I sent to Colonel Barnett, District Engineer of the Corps of Engineers, pertaining to this problem, and enclosing sludge sampling data collected by the Interstate Sanitation Commission and our Department of Environmental Protection.

Sincerely,

WILLIAM T. CAHILL,
Governor.

1948

GENERAL ASSEMBLY OF NEW JERSEY,
Trenton, February 16, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*Cannon House Office Building,
Washington, D.C.*

DEAR MR. SANDMAN: I am terribly disturbed by the extent of off-shore dumping which goes on daily in the Atlantic Ocean, off our coast. As you probably know, our Assembly Committee on Air and Water Pollution and Public Health, under the chairmanship of Assemblyman Kenneth Wilson, Essex County, has been quite active in trying to seek the end of this practice.

I know of your many efforts on behalf of the ecology of the off-shore areas. Please be assured of my further support of your attempts to improve the situation.

Sincerely,

BARRY T. PARKER,
Speaker.

STATE OF NEW JERSEY,
February 2, 1971.

HON. CHARLES W. SANDMAN,
*House of Representatives,
Washington, D.C.*

DEAR CONGRESSMAN SANDMAN: Thank you very much for your letter of January 27, 1971 with the enclosed material concerning open dumping. I will have my staff review this material and decide if there is a way that we can help by having legislation passed here in New Jersey.

Thank you for your interest in this very troublesome matter.

Very truly yours,

GEORGE F. KUGLER, Jr.,
Attorney General.

NEW MEXICO

STATE OF NEW MEXICO,
OFFICE OF THE GOVERNOR,
Santa Fe, February 18, 1971.

HON. CHARLES W. SANDMAN, Jr.,
*House of Representatives,
Washington, D.C.*

DEAR CHARLIE: Thank you for your letter of January 26, 1971, relative to legislation pertaining to pollution of our rivers, lakes and streams in the United States.

My message to the State Legislature covered this subject, and we anticipate effective legislation to be enacted.

It is good to know that you are taking the lead in introducing this important legislation in the Congress of the United States.

Kindest personal regards,
Most sincerely,

BRUCE KING,
Governor.

NEW YORK

THE ASSEMBLY,
STATE OF NEW YORK,
Albany, February 18, 1971.

Mr. CHARLES SANDMAN, Jr.,
*Cannon Building,
Washington, D.C.*

DEAR MR. SANDMAN: Thank you for your letter and the copy of your remarks in the Congressional Record concerning legislation to control and eliminate indiscriminate dumping of waste in the territorial waters of the United States and international waters.

I am deeply concerned with the problem of Environmental Conservation and have referred your letter and remarks to my consul for his consideration.

Sincerely yours,

PERRY B. DURYEA, Jr.,
Speaker.

1949

NEW YORK, N.Y., February 5, 1971.

CHARLES W. SANDMAN, Jr.,
Congress of the United States,
House of Representatives, Washington, D.C.

DEAR REPRESENTATIVE SANDMAN: Thank you for your letter of January 27, 1971, enclosing a copy of the excellent bill you introduced in Congress to prohibit the dumping of waste in waterways.

I quite agree that the states should enact similar legislation. New York, indeed has had such a law since 1966. Section 33-c of our Navigation Law prohibits the discharge or deposit "into the waters of this state, from any watercraft, marina or mooring of sewage or other liquid solid materials which render the water unsightly, noxious or otherwise unwholesome so as to be detrimental to the public health or welfare or to the enjoyment of the water for recreational purposes."

The statute also prohibits the deposit or discharge into the waters of this state of "any litter from any watercraft, marina or mooring." Violation of these provisions is a criminal offense.

I certainly share your concern over the continued discharge of waste into our waterways and am hopeful that Congress and the states can achieve a solution to these problems through the prompt enactment of legislation such as the bill you introduced.

Sincerely,

LOUIS J. LEFKOWITZ,
Attorney General.

NORTH DAKOTA

STATE OF NORTH DAKOTA,
EXECUTIVE OFFICE,
Bismarck, January 29, 1971.

HON. CHARLES W. SANDMAN, Jr.,
Congress of the United States,
House of Representatives, Washington, D.C.

DEAR CONGRESSMAN SANDMAN: Thank you for bringing to my attention the legislation you introduced to control the indiscriminate dumping of wastes in territorial and international waters.

Sincerely yours,

WILLIAM L. GUY,
Governor.

OKLAHOMA

STATE OF OKLAHOMA,
OFFICE OF THE GOVERNOR,
Oklahoma City, February 11, 1971.

HON. CHARLES W. SANDMAN, Jr.,
Congress of the United States,
House of Representatives, Washington, D.C.

DEAR CONGRESSMAN: Thank you very much for your letter and copy of your introductory remarks on the floor of the House on January 21, 1971.

You may be sure that I agree that this is an area of vital concern and that Oklahoma will wish to take every precaution to protect our water.

Would you please send me a copy of the Legislation you have introduced?

With best wishes,

Sincerely,

DAVID HALL.

1950

OREGON

OFFICE OF THE GOVERNOR,
Salem, February 2, 1971.

HON. CHARLES W. SANDMAN, Jr.,
Member of Congress,
Washington, D.C.

DEAR MR. SANDMAN: Because of Governor McCall's absence from the office, he has asked that I respond to your letter.

Oregon agrees with the purpose of your legislation, and hopes that action can be accomplished by the Congress. However, Oregon does not have any dumping of these wastes into the territorial waters over which we have control. If such a problem develops, ORS 449.083 provides for control by a waste discharge permit system which should tie in completely with the permit system envisioned by your proposal.

Best wishes.

Sincerely,

ROBERT G. DAVIS,
Executive Assistant.

PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA,
GOVERNOR'S OFFICE,
Harrisburg, February 18, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CHARLIE: Thanks very much for your recent letter calling my attention to the legislation you introduced in Congress to control and eventually eliminate indiscriminate dumping of wastes in the territorial waters of the United States and in international waters.

As you know, I have a long-standing interest in this problem, and we are giving careful consideration to ways of improving Pennsylvania law in this area.

With all good wishes, I am

Sincerely,

MILTON J. SHAPP,
Governor.

RHODE ISLAND

STATE OF RHODE ISLAND & PROVIDENCE PLANTATIONS,
Providence, March 18, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN SANDMAN: Please excuse my delay in replying to your letter of January 26 and the recommendation that all states adopt laws to control the indiscriminate dumping of wastes into the off shore waters within the jurisdiction of the respective states.

Our present water pollution control law, Title 46, Chapter 12, of the General Laws of 1966 as amended, prohibits a new discharge of any waste into the waters of the State without having obtained an order of approval from the Director of the Rhode Island Department of Health. In other words, we do possess the authority to control indiscriminate dumping as you recommended in your letter to me.

I remain hopeful that this information will be of assistance to you, and I thank you for writing me on this matter of mutual concern.

Kind regards.

Sincerely,

FRANK LICHT,
Governor.

1951

SOUTH CAROLINA

STATE OF SOUTH CAROLINA,
OFFICE OF THE GOVERNOR,
Columbia, February 10, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN: Thank you for advising me of the legislation which you introduced to eliminate indiscriminate dumping of wastes in the territorial waters of the United States and in international waters.

I appreciate your writing me in this regard and wish to assure you of my interest.

With kindest regards, I am
Sincerely,

JOHN C. WEST,
Governor.

SOUTH DAKOTA

STATE OF SOUTH DAKOTA,
SENATE CHAMBERS,
Pierre, February 11, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN: In regard to your letter of January 26, to Governor Richard Kneip pertaining to legislation you are introducing, we find that due to the fact that we have no coastal waters or major rivers here we have no dumping problems.

We are trying to solve smaller problems in different ways and have many bills in our legislative session right now that will accomplish the means that you have set out to do.

Yours truly,

BILL DOUGHERTY,
Lieutenant Governor.

TEXAS

STATE OF TEXAS,
HOUSE OF REPRESENTATIVES,
Austin, February 4, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN SANDMAN: Your letter of January 27 has been received, and I appreciate your taking the time and effort to acquaint me with your proposed legislation.

To my knowledge, this State does not at the present time have statutes dealing with this particular aspect of the problem, and your suggestion is most helpful.

Again, I thank you for bringing this matter to my attention. A working partnership between Congress and the States is absolutely necessary if we are to conceive optimum solutions to the problems which confront us. I wish you luck with your proposal in Congress.

Best regards.
Sincerely,

G. F. (Gus) MUTSCHER.

1952

UTAH

STATE OF UTAH,
OFFICE OF THE GOVERNOR,
Salt Lake City, February 17, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN SANDMAN: I appreciate very much your sending me a copy of your legislation to control dumping of waste in territorial waters. I believe we have good control over water pollution in Utah, and I am pleased to see this kind of legislation moving along on the national level.

Thank you again.

Sincerely,

CALVIN L. RAMPTON,
Governor.

VERMONT

STATE OF VERMONT,
EXECUTIVE CHAMBER,
Montpelier, February 4, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives,
Washington, D.C.

DEAR MR. SANDMAN: Thank you for your letter of January 26 regarding your proposed legislation to control ocean dumping.

Vermont, of course, is an inland state. However, we do have an extensive coastline along our lakes, particularly Lake Champlain. The last session of legislature passed my water pollution control proposals which prohibit any pollution of the State's waters, including the dumping of any substance, without a permit from the Water Resources Department. The Act more than accomplishes the intent of your bill.

I am pleased that Congress is beginning to move decisively to control water pollution. If I may be of assistance, please do not hesitate to write me.

Cordially,

DEANE C. DAVIS.

STATE OF VERMONT,
HOUSE OF REPRESENTATIVES,
Montpelier, February 9, 1971.

MR. CHARLES W. SANDMAN, Jr.,
Member of Congress,
Washington, D.C.

DEAR SIR: With reference to your letter of January 27th, concerning legislation to control and eventually eliminate indiscriminate dumping of wastes in the territorial waters of the United States and in international waters.

I have referred your communication to the House Natural Resources Committee. Thank you.

Sincerely,

WALTER L. KENNEDY,
Speaker.

VIRGINIA

COMMONWEALTH OF VIRGINIA,
OFFICE OF THE GOVERNOR,
Richmond, January 29, 1971.

HON. CHARLES W. SANDMAN, Jr.,
House of Representatives, Washington, D.C.

DEAR CHARLIE: Many thanks for your letter of January 26 and enclosed copy of your remarks to the House of Representatives regarding legislation to end indiscriminate ocean dumping.

Our Virginia General Assembly is currently in special Session to deal specifically with recodification made necessary as a result of our Constitutional revision. Additionally, they are charged with the task of Congressional Redistricting.

1953

Legislation such as you are suggesting could not be considered before the regular Session of the General Assembly, convening in January of 1972. In the meantime, I will have my staff study your bill in order that we may prepare a legislative proposal for consideration at the next regular Session of the Virginia General Assembly.

Best regards.
Cordially,

LINWOOD HOLTON.

COMMONWEALTH OF VIRGINIA,
OFFICE OF THE ATTORNEY GENERAL,
Richmond, February 3, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
Member, House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN SANDMAN: This will acknowledge receipt of your letter of January 27, 1971, to the Attorney General in regard to your proposed legislation on the control and elimination of indiscriminate dumping of wastes in the territorial waters of the United States and in international waters. Please find enclosed herewith a copy of an order issued by the State Water Control Board of Virginia when it was faced with ocean disposal practices of government and industry. We shall follow your bill with interest and would appreciate information from you from time to time.

For the Attorney General, I am
Sincerely,

GERALD L. BALILES,
Assistant Attorney General.

WASHINGTON

STATE OF WASHINGTON,
OFFICE OF THE GOVERNOR,
Olympia, February 19, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
U.S. Representative,
Washington, D.C.

DEAR CHARLIE: Thank you for your letter and a copy of the Congressional Record regarding your bill on waste dumping in territorial waters. I read your proposal and referred it to our Department of Ecology.

Although I wish you all the success, my office simply cannot handle another major item of legislation. We currently have over 65 executive request bills in the session of our state legislature. My staff is overtaxed now trying to keep up with all of them.

One of these is an oil spill bill which is quite comprehensive and has a reasonably good chance of passage.

Please let me know if there is something else I can do.

Sincerely,

DANIEL J. EVANS,
Governor.

WEST VIRGINIA

STATE OF WEST VIRGINIA,
OFFICE OF THE GOVERNOR,
Charleston, March 1, 1971.

Hon. CHARLES W. SANDMAN, Jr.,
Member, U.S. House of Representatives,
Washington, D.C.

DEAR CHARLIE: Thank you for your letter advising me that you have introduced legislation to control and eliminate indiscriminate dumping of wastes in the territorial waters of the United States and in international waters. I commend you for taking the initiative in this effort to prevent the desecration of our oceans and waters, and hasten to assure you of my interest in the measure which you have introduced.

1954

You will, no doubt, be interested to know that we in West Virginia are moving boldly to preserve the integrity of our intrastate waters and I have caused several measures to be introduced in the current session of the West Virginia Legislature in this regard. I would call your attention to one measure in particular, HB 923, which creates the West Virginia Oil and Gas Conservation Commission. This measure is particularly important because it prohibits the dumping of wastes into our rivers and streams.

As you know, concern with the environment is the forefront of public issues these days, and it is gratifying that so many are taking an active interest in preserving and protecting our natural heritage.

With very best regards, I am

Sincerely yours,

ARCH A. MOORE, Jr.,
Governor.

WISCONSIN

STATE OF WISCONSIN,
OFFICE OF THE GOVERNOR,
February 1, 1971.

CHARLES W. SANDMAN, Jr.,
Member of Congress,
Washington, D.C.

DEAR REPRESENTATIVE SANDMAN: Thank you for your letter of January 26 relating to legislation to control the indiscriminate dumping of wastes in the territorial waters.

I am currently studying your suggestion to introduce similar legislation here in Wisconsin. Thank you for your interest.

Sincerely,

PATRICK J. LUCEY,
Governor.

Senator MUSKIE. Thank you very much, Congressman Sandman.
Senator Boggs?

Senator BOGGS. Mr. Chairman, Congressman du Pont of Delaware had very much hoped to attend today's hearing. However, he had a previous commitment on behalf of the President and I am sure you can understand why he could not alter his schedule.

Nevertheless, Congressman du Pont has put together a most articulate and persuasive statement on the subject of ocean dumping, and I would ask permission that his statement, together with a covering letter, be printed in the hearing record at this point, following Congressman Sandman's remarks.

Senator MUSKIE. It is so ordered.

(Statement referred to follows:)

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., March 25, 1971.

Senator J. CALEB BOGGS,
Washington, D.C.

DEAR CALE: I am enclosing my statement to be submitted at the hearings in Rehoboth, on March 26, before your Subcommittee on Air and Water Pollution.

I regret that I am unable to give my statement personally, but due to a previous commitment, I will be out of the state on behalf of the President.

I certainly hope that your colleagues find these hearings productive.

Sincerely yours,

PIERRE S. DU PONT, IV,
Member of Congress.

1955

STATEMENT SUBMITTED BY HON. PIERRE S. DU PONT, IV, A U.S. REPRESENTATIVE
FROM THE STATE OF DELAWARE

Mr. Chairman, I first would like to say how gratifying, it is to see your distinguished Committee appear in Rehoboth to investigate a matter which is not only of great local concern but also of critical national and international importance.

I regret that other commitments prevent me from testifying before your Committee in person, but perhaps my thoughts will be of value to you in the record. I am particularly interested in your investigation into the dumping problem because I serve on the Committee in the House of Representatives that will be concerned with these matters. The Oceanographic Subcommittee of the Merchant Marine and Fisheries Committee of the House will hold hearings in Washington on April 5, 6, and 7 to consider proposed anti-dumping legislation. I look forward to the benefit of your conclusions today in guiding our committee in its future deliberations. There are more than 15 anti-dumping measures already before our Subcommittee, so there is no lack of material with which to work.

During the testimony before the Committee today, I am sure that you will hear a great deal about the dumpings of sludge that take place not far off our coast line. I am also certain that you will hear testimony from people far more knowledgeable than myself in these matters. Rather than risking duplication of their remarks, I would like to make a few general observations as a member of the Merchant Marine and Fisheries Committee and also as a layman looking at the overall ramifications of ocean dumping policy.

First, no one can deny the need for some form of dumping regulations, not only to preserve the quality of our shoreline, but to preserve the oyster beds and fishing grounds further off the coastline.

I think that the recent incident which involved dumping of arsenic by the vessel *Nando Fassio*, exemplifies the critical nature of the problem. We simply do not have the regulatory tools available to deal with this problem effectively. At this point, any step toward controlling dumping would be an improvement.

Yet an attempt to be too pervasive and all-encompassing in our initial regulations may prove to be counter productive. Since this is a new area of regulation it is possible that hastily conceived stringent regulations could create a more serious future sea and land based problem. Legislation must be carefully constructed to strike a balance between these forces.

While I think that it is best to leave the guidelines and specifics of regulation to the discretion of an agency such as the EPA, which has the expertise to formulate workable, realistic regulations, I believe that some restrictions should be set within the provisions of ocean dumping legislation. The prohibitions against nerve gas dumping or atomic waste dumping are a case in point.

Because, ocean dumping will involve use of international waters. I think that it would be wise for this country to demonstrate to the world that we will not abuse these waters. The controversy over the dumping of nerve gas last year catalyzed adverse world opinion, and I think that legislation which shows our intention to use the international waters judiciously may help restore some of the confidence of the world community.

In addition to these provisions, a sound ocean dumping policy must include provisions for promoting marine research. Our knowledge of the marine environment is limited, and I think that, because of such limitations restrictive ocean dumping permits should be issued pursuant to an environmental impact evaluation.

I think that this gap of our knowledge has become very apparent recently, and is exemplified by the recovery of the rescue submarine, *Alvin*.

Recently, a Woods Hole oceanographic team recovered, the sunken experimental vessel from a great depth. There was a good deal of food left on board, and because the food looked remarkably well preserved, the scientists ran tests, and found that this material had decayed at rates about five times slower than was initially expected.

The immediate conclusion was that organic matter decays very slowly at depth, and that many assumptions long held about the sea zone are now under review.

Not only does this point to a void in fundamental knowledge about the marine ecosystem, but it also suggests that dumping of organic wastes into the ocean and effect of the ecosystem will have to be reexamined.

This incident, along with conversations with some oceanographers, has convinced me that our knowledge of the deep sea zone is so limited, that we need immediate research. The urgency of such research is further compounded by the

fact that we may soon be issuing permits to dump quantities of waste into the ocean zone without having any accurate measure of environmental impact.

The initiation of a permit system on ocean dumping is an important step in preserving the marine environment; however, I hope that we never lose sight of the fact that this is just a rudimentary measure. Our eventual goal must be to provide alternatives to ocean dumping such as recycling of waste material.

Senator MUSKIE. I would like now to present our first witness from the other side of the podium, and I would like to say just a word about him. He is now chairman of the Council on Environmental Quality. However, he is as a private citizen, as well as a public servant, highly interested and concerned with the problems of environment and ecology, very knowledgeable, very articulate. He has an enviable job as Chairman of the Council of Environmental Quality, an agency created just 2 years ago. In that capacity he must serve not only as the national conscience on ecology, but he also must develop effective policies to implement that conscience. The first part is not so difficult; all one needs is the sensitivity of Russell Train. The second is more difficult because it involves the practical problems of adjusting a highly technological and industrialized society, which has been built without proper concern for the environment, to the impairments of the environment as we see them today. That is a difficult responsibility, and I can't think of any one I would rather see discharging it than our next witness, Mr. Russell Train, chairman of the Council of Environmental Quality.

STATEMENT OF HON. RUSSELL E. TRAIN, CHAIRMAN, COUNCIL ON ENVIRONMENTAL QUALITY

Mr. TRAIN. Mr. Chairman, in opening let me thank you warmly for your very generous, and I will say overly generous introductory remarks, and I would certainly want you to know that the Council on Environmental Quality as an institution owes a great deal to this subcommittee and to the full committee for support, staffing and interest since its inception.

Mr. Chairman and Senator Boggs, I appreciate the opportunity to meet with your subcommittee here in Rehoboth Beach and to testify in support of the President's proposals for the control of ocean dumping. Protection of the marine environment has been and continues to be a high priority concern of this administration.

This subcommittee is certainly to be commended for its early attention to this subject in this Congress.

The Council on Environmental Quality has been deeply concerned about and involved with the problems of ocean dumping from its inception slightly over one year ago. In his message to Congress of April 15, 1970, on the subject of Great Lakes and other dumping, the President directed the Council to make a study and report on the ocean disposal of wastes. Through the summer of last year the Council worked to prepare a report to the President on the subject. On October 7, 1970, the President transmitted the completed report to Congress, endorsing the council's recommendations and stating that specific legislative proposals in the form of a bill would be presented to the 92d Congress. The bill was transmitted to Congress as a part of the President's environmental message on February 8th. This bill was introduced by Senator Boggs as S. 1238 on March 16th, and was

cosponsored by some 33, I believe, other members of the Senate from both parties including Senators Randolph, Cooper, Muskie, Beall, Buckley and Roth; and as Senator Case has mentioned he has another bill directed to the same general problem. (See appendix for S. 1258, introduced by Senator Boggs and S. 1082, introduced by Senator Case.)

Members of the council and our staff have continued their study of the extent and effects of ocean dumping since the completion of our report and the legislative proposal. In fact, recently, Dr. Gordon MacDonald, one of the council members, examined a designated dumping area for sewage sludge which lies just off the coast here at Rehoboth Beach.

During our formal study I became convinced that there is a critical need for Federal legislation to implement a national policy on ocean dumping and I would like briefly to present our reasons for reaching this conclusion and for adhering to it in the light of our subsequent work. Then, I would like to describe our legislative proposal and the way in which it would apply to a variety of circumstances. The closing portion of my remarks will deal with international initiatives and prospects in this area.

We often do not take adequate account of the fact that oceans—146 million square miles of water surface—cover over 70 percent of the earth. They are critical to maintaining the world's environment, contributing to the oxygen-carbon balance in the atmosphere, affecting global climate, and providing the base for the world's hydrological system. Oceans are economically valuable to man, providing, among other necessities, food and minerals.

The coastlines of the United States are long and diverse, ranging from the tropical waters of Florida to the Arctic coast of Alaska. These areas, as biologically productive as any in the world, are the habitat for much of our fish and wildlife. They also provide transportation, recreation, and a pleasant setting for more than 60 percent of the Nation's population.

These waters are also the final receptacle for many of our wastes. Sewage, chemicals, garbage, and other wastes are carried to sea through the watercourses of the Nation from municipal, industrial, and agricultural sources or directly by barges, ships, and pipelines.

The amount of wastes actually transported and dumped in the ocean is small in terms of the total volume of pollutants reaching the oceans. But even so, the Council estimated that in 1968 slightly over 48 million tons of waste were dumped at sea off the shores of the United States. Of this total, the main sources of ocean dumping were:

1. Dredge spoils—the solid materials removed from the bottom of water bodies, generally for the purpose of improving navigation, 80 percent of the total by weight;
2. Industrial wastes—acids, refinery, pesticide, and paper mill wastes, and assorted liquid wastes, 10 percent;
3. Sewage sludge—the solid material remaining after municipal waste water treatment, 9 percent;
4. Construction and demolition debris—masonry, tile, stone, excavation dirt, and similar materials, about 1 percent;
5. Solid waste—the common refuse, garbage, or trash generated by residences, commercial, agricultural, and industrial establishments, less than 1 percent.

And, as we all know, small but potent tonnages of other materials, such as explosive munitions and chemical war agents, have also been dumped.

Tonnages are not a good indicator of the effect of the dumped material. Dredge spoils, for example, can be contaminated with pollutants from industrial, municipal, agricultural, and other sources on the bottom of water bodies. If these contaminants are oxygen-demanding materials, they can reduce the oxygen in the receiving waters to levels at which certain aquatic life cannot survive. Heavy metal contamination can also create water concentrations toxic to marine life. Sewage sludge, whether or not digested to control odors and pathogens, can also contain significant concentrations of heavy metals and of oxygen-demanding materials.

Most of the dumping takes place in designated sites for the disposal of certain types of wastes. The disposal site off Rehoboth Beach, for example, is used for digested and undigested sewage sludge. The cities of Philadelphia, Camden, and Bridgeton each use this particular site. The effects of dumping in a designated area can be disastrous. In this area, outside the dumping zone, Dr. MacDonald of the Council found a thriving clam population. In the dumping area he found sludge worms, dead clams, and one living clam which had such a poor reaction to stimulus that it was obviously a very sick clam indeed.

The problem that faces us is not limited to the effects of materials presently being dumped. The volume of waste dumping is growing rapidly, and the future impact of dumping could increase significantly relative to other sources of pollution in the ocean. Because the capacity of land-based disposal sites is becoming exhausted in some coastal cities, some communities are increasingly looking to the ocean for disposal. And, higher water-quality standards could lead industries to also look to the ocean for disposal.

A number of alternatives are presently available for wastes now being dumped at sea. Our report discusses these alternatives in detail and also evaluates present efforts to develop other disposal options, some of which, such as land reclamation and recycling, can be environmentally beneficial. After an evaluation of the effects of specific types of wastes currently being dumped and of the alternatives available to dumping, the Council recommended adopting certain dumping policies for the given types of materials. With your permission I will summarize these policies.

OCEAN DUMPING POLICY

Ocean dumping of undigested sewage sludge should be stopped as soon as possible and no new sources allowed.

Ocean dumping of digested or other stabilized sludge should be phased out and no new sources allowed. In cases in which substantial facilities and/or significant commitments exist, continued ocean dumping may be necessary until alternatives can be developed and implemented. But continued dumping should be considered an interim measure.

Ocean dumping of existing sources of solid waste (other than sewage sludge) should be stopped as soon as possible. No new sources should be allowed, i.e., no dumping by any municipality that currently does not do so, nor any increase in the volume by existing municipalities.

Ocean dumping of polluted dredge spoils should be phased out as soon as alternatives can be employed. In the interim, dumping should minimize ecological damage. The current policy of the Corps of Engineers on dredging highly polluted areas only when absolutely necessary should be continued, and even then, navigational benefits should be weighed carefully against environmental costs.

The current policy of prohibiting ocean dumping of high-level radioactive wastes should be continued. Low-level liquid discharges to the ocean from vessels and land-based nuclear facilities are, and should continue to be, controlled by Federal regulations and international standards. The adequacy of such standards should be continually reviewed. Ocean dumping of other radioactive wastes should be prohibited. In a very few cases, there may be no alternative offering less harm to man or the environment. In these cases ocean disposal should be allowed only when the lack of alternatives has been demonstrated. Planning of activities which will result in production of radioactive wastes should include provisions to avoid ocean disposal.

No ocean dumping of chemical warfare materials should be permitted. Biological warfare materials have not been disposed of at sea and should not be in the future. Ocean disposal of explosive munitions should be terminated as soon as possible.

Ocean dumping of industrial wastes should be stopped as soon as possible. Ocean dumping of toxic industrial wastes should be terminated immediately, except in those cases in which no alternative offers less harm to man or the environment.

Ocean dumping of unpolluted dredge spoils, construction and demolition debris, and similar wastes which are inert and nontoxic should be regulated to prevent damage to estuarine and coastal areas.

Use of waste materials to rehabilitate or enhance the marine environment, as opposed to activities primarily aimed at waste disposal, should be conducted under controlled conditions. Such operations should be regulated, requiring proof by the applicant of no adverse effects on the marine environment, human health, safety, welfare and amenities.

Current regulatory activities and authorities are not adequate to carry out that policy. States do not exercise extensive control over ocean dumping, and their authority ordinarily extends only within a 3-mile territorial sea, while most dumping occurs outside these waters.

Regulatory authority of the Army Corps of Engineers over ocean dumping is also largely confined to the territorial sea. Because the Corps has responsibility to facilitate navigation, chiefly by dredging navigation channels, it is in the position of regulating activities over which it also has operational responsibility. The Coast Guard enforces several Federal laws regarding pollution but has no direct authority to regulate ocean dumping. The Atomic Energy Commission has responsibility for water-quality standards within the territorial waters, but does not have authority to require permits for ocean dumping or to regulate disposal outside territorial waters.

To control ocean dumping adequately, the administration bill would provide a ban on the unregulated dumping of all materials into the oceans, estuaries, and Great Lakes, and would provide authority to limit strictly ocean disposal of any materials harmful to the marine environment. It would require a permit from the administrator of

EPA for the transportation and dumping in estuaries, the Great Lakes, and the oceans anywhere in the world of wastes which originate in the United States and for dumping by United States and foreign nationals in our territorial waters and in the contiguous zone when the dumping would affect our territory or contiguous zone.

The administrator would be empowered to ban ocean dumping of certain materials and to designate safe disposal sites for others. Transportation for dumping, dumping without a permit, or dumping in violation of a permit would be subject to civil and criminal penalties, and these, too, are at the rate of \$50,000 per offense. The Coast Guard would perform surveillance and other enforcement activity.

EPA would be authorized to regulate dumping by private persons or entities and by all Federal, State, and, in appropriate cases, foreign organizations would have to comply with the permit and standard-setting provisions of the proposal.

Specific considerations are set out for use by EPA in developing criteria for ocean dumping. EPA could refine and modify the criteria as additional knowledge on the effects of ocean dumping is gained. In no case could dumping violate Federal-State water-quality standards in the U.S. territorial sea or contiguous zone. The proposal would encourage Federal research on the effects of materials dumped or spilled into the oceans and the development of means of monitoring and controlling such disposal. In developing the criteria and the enforcement programs, EPA would work with the Coast Guard and the National Oceanic and Atmospheric Administration.

I should also point out that the bill specifically requires that the administrator in arriving at criteria for the granting of permits for dumping must, in addition to the ecological and other impacts of such dumping, take into account the availability of alternative sites and methods of disposal. I know that is a matter of interest to this committee.

Our premise is that action is necessary now to avoid a serious national problem from ocean dumping, and as Senator Case has said, the problem is already critical in certain areas. Yet, the proposed action is not all preventive. Adequate regulation could restore many of the presently damaged areas. Here in the Rehoboth Beach situation, the cities which are now dumping sewage sludge would be required to seek an EPA permit before they could dump further. This requirement would apply regardless of whether the sludge was dumped in the waters of the territorial sea, the contiguous zone, or the high seas, because the material originates within the United States. The same situation and permit requirement would also be present in the circumstances of such recently publicized instances of ocean dumping as the industrial dumps or arsenic-bearing material from the Philadelphia area.

Congress now has before it a number of other legislative proposals which also seek to control ocean dumping. S. 523 introduced by you, Mr. Chairman, would amend the Federal Water Pollution Control Act by providing for a new paragraph 10(d)(2) which would prohibit discharge into the territorial sea or contiguous zone, or transport from any U.S. port for the purpose of discharge into the ocean of any matter, without a permit from the administrator of EPA. We obviously concur with the jurisdictional approach taken by this provision and with the regulatory concept underlying it. But, our

experience in this area leads us to suggest that implementation of such a concept would best be achieved if specific criteria for dumping, quite apart from water-quality standards, would be set up and implemented. Such criteria could particularly take into account the sporadic, but often very concentrated nature of the dumps which are now being made at sea. And, toxic materials are often dumped in containers creating a long-term hazard to the marine environment but not necessarily violating water-quality standards.

Efficient, effective and consistent implementation of a regulatory statute would also be enhanced if that statute dealt specifically with the dispersed and inadequate control authorities which presently exist. Duplicative permit requirements from operating agencies could be eliminated. Further, many of these other authorities are intended for purposes other than control of ocean dumping. For example, the Refuse Act and other sections of the Rivers and Harbors Act of 1899 provide important environmental controls on discharges into, and construction or dredging and filling activity in navigable water. Implied supersession would result from more recently enacted overlapping provisions. Dealing with the relationship of these other authorities to an ocean dumping statute would allow these other valuable purposes to be served without the problems of vagueness arising from such supersession.

We note also that Senator Williams has introduced S. 1011 which would amend the Federal Water Pollution Control Act to provide pollution control for marine waters. We are not in a position to comment authoritatively on the bill's jurisdictional provisions. But, we would observe that, in our judgment, specific control over the biologically productive and sensitive areas in our estuaries and territorial sea is essential, and S. 1011 does not provide control in such areas. As I mentioned earlier, most of the material dumped is dredge spoils, and this dumping takes place near dredge sites, that is, most often near shore. Again, controls in addition to water quality standards are necessary to do an adequate regulatory job for these cases.

A further bill, S. 1082, introduced by Senator Case, would regulate the discharge from vessels of wastes originating in the United States. It would bar the discharge of any wastes in the waters above the Continental Shelf adjacent to the United States, and would further ban entirely the discharge of such wastes after 5 years. We suggest that discharges should not be limited to those occurring only from vessels. Dumping of dredge spoils and other similar material often does not take place from vessels. Moreover, we would not at present favor an absolute ban on all dumping. Such action would foreclose the Administrator of EPA from considering a disposal option which in any one given case may be environmentally the most desirable, or put another way, the least undesirable. We should note as well that some dumped materials originate in the sea or are dredged from the sea floor. Returning these materials to the sea in a carefully selected site may be the action most in accord with maintaining and preserving the existing land and marine environments.

May I state just in passing at this point, Mr. Chairman, that while I have commented on a number of these bills pointing out some of our concerns, I think that they are all very much on the right track. We welcome all of them as strong evidence of the responses and the general Congressional interest in taking effective action on this

very important problem. We look forward to working closely with you and other committees that may take an interest, and members of Congress in working up the best possible legislation.

My remarks have been extensive and I would not wish to prolong them further except to comment briefly on our international efforts and prospects in this area.

Through domestic legislation such as that which we have proposed, in my judgment very effective action can be taken to curb the present and potentially harmful effects of ocean dumping. Further, such action can be taken consistent with accepted principles of international law. Very nearly all of our problems in the United States with ocean dumping arise as the result of disposing of wasted material which originates within the United States. We can and should, through domestic legislation, control the transport for dumping of such material. We can and should also control all dumping in our territorial sea and dumping in our contiguous zone which affects our territory or territorial sea. And, as the President has stated, we will urge nations to adopt similar measures and enforce them. But, a completely comprehensive system for the control of ocean dumping would involve regulation of all dumping of certain materials, wherever they may be generated, and wherever and by whomever they may be dumped. The administration bill contains a section requiring the Secretary of State to "seek effective international action and cooperation to insure protection of the marine environment * * *" The State Department, in conjunction with the Council and other concerned agencies, is taking steps to assure accomplishment of this objective. We are working with the Preparatory Committee for the 1972 United Nations Conference on the Human Environment to be held at Stockholm to develop for its agenda the pollution of the marine environment as an item deserving full attention. We are taking an active part in the number of international bodies which are dealing with various aspects of marine pollution, including the 1973 Law of the Sea Conference, and the 1973 IMCO Conference on Oil Pollution, as well as the 1972 United Nations Conference on the Human Environment to be held at Stockholm. In the months ahead, we will be deciding upon the details of action appropriate to the United States for each conference.

Shortly after the President sent his message on ocean dumping to the Congress last October, I visited Japan at the request of the President to discuss mutual environmental problems with Prime Minister Sato and other members of his government. I found a great interest in the President's proposals for control of ocean dumping, and last December the Government of Japan submitted marine pollution legislation to the Diet.

Earlier this month, I had occasion to discuss ocean dumping with the responsible ministers in London, Bonn, and Brussels. As you know, the NATO Committee on the Challenges to Modern Society (CCMS), set up at the personal initiative of President Nixon, has recently agreed in principle to a policy to halt all intentional discharges of oily wastes into the seas by 1975, if possible, and by 1980 at the latest. As the U.S. representative to CCMS, I have been able to emphasize to our NATO associates our Government's strong commitments to protect the marine environment. Secretary Volpe has also made strong representations of the importance of this policy to our NATO associates. In

London, I recently had discussions with the Secretary-General of IMCO and have reason to believe that IMCO will support the principles embodied in the CCMS agreement.

Mr. Chairman, I have welcomed this opportunity to emphasize this administration's determination to protect the marine environment, as well as our own Council's strong and continuing interest in furthering his goal which is of such great importance to the well being of all the peoples of the world. I am convinced that cooperative efforts for environmental protection and improvement constitute a significant opportunity for leadership and initiative by the United States in international affairs. The need to control pollution of the seas is a major opportunity for such leadership and initiative at this time.

If the United States is in fact to exercise leadership in this critical area, if it is to persuade other nations to control their ocean disposal of wastes, then it is essential that the United States first put its own house in order. In my opinion, prompt and favorable action by Congress to establish effective regulation of ocean dumping is a prerequisite to action by other nations.

Again, I thank you for this opportunity to be here, Mr. Chairman. We look forward to working with your committee and your staff on the preparation of legislation.

And again, I commend this committee for its early attention to this very important problem.

Senator MUSKIE. Thank you very much, Mr. Train.

I think this would be the appropriate point at which to insert in the record the report of your Council to the President on ocean dumping; it is dated last October, and without objection it will be included in the record.

(The report referred to follows:)

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OCEAN DUMPING

A National Policy

**A Report to the President
prepared by the
Council on Environmental Quality**

October 1970

(1965)

Foreword

OCEANS—140 million square miles of water surface—cover over 70 percent of the earth. They are critical to maintaining the world's environment, contributing to the oxygen-carbon dioxide balance in the atmosphere, affecting global climate, and providing the base for the world's hydrologic system. Oceans are economically valuable to man, providing, among other necessities, food and minerals.

The coastlines of the United States are long and diverse, ranging from the tropical waters of Florida to the Arctic coast of Alaska. These areas, as biologically productive as any in the world, are the habitat for much of our fish and wildlife. They also provide transportation, recreation, and a pleasant setting for more than 60 percent of the Nation's population.

These waters are also the final receptacle for many of our wastes. Sewage, chemicals, garbage, and other wastes are carried to sea through the watercourses of the Nation from municipal, industrial, and agricultural sources or directly by barges, ships, and pipelines.

Industrial liquid wastes are the largest source of pollution in coastal and estuarine regions, followed by municipal liquid wastes. Agricultural pollutants from land runoff, animal wastes, pesticides, and fertilizers add to the load of wastes ultimately reaching the ocean. Sewage from vessels and spilled oil are two highly visible sources of marine pollution. And a large part of air pollutants eventually end up in the ocean, directly or through runoff from the land.

The amount of wastes transported and dumped in the ocean is small in terms of the total volume of pollutants reaching the oceans. But in the future the impact of ocean dumping will increase significantly relative to other sources. Although Federal laws on oil and vessel pollution and Federal-State

water quality standards for land-based discharges will reduce the contribution of wastes from these sources, uncontrolled dumping in the ocean could increase greatly.

Recognizing the importance of this problem, the President directed the Council on Environmental Quality to study ocean dumping. In his April 15, 1970, message to the Congress,¹ he asked the Council to work with other Federal agencies and with State and local governments on a comprehensive study that would result in research, legislative, and administrative recommendations.

The Council is grateful to members of a Federal Task Force and individuals from their agencies² for preparing material for consideration at meetings of the Task Force, for their review of report drafts, and most important of all, for providing guidance in formulating the recommended policy. Helpful assistance was also received from agencies and individuals in State and local government and from scientists and academicians, including the National Academy of Sciences and the National Academy of Engineering.

The Council is also indebted to a number of excellent studies. These include the studies on the New York Bight, one initiated by the Corps of Engineers and another prepared by an Ad Hoc Committee for the Secretary of the Interior; the 20-city survey of barged wastes, prepared by the Dillingham Corporation under contract to the Bureau of Solid Waste Management; the study of Waste Management Research Needs, by the National Academy of Sciences Committee on Oceanography-National Academy of Engineering Committee on Ocean Engineering; the National Estuarine Pollution Study, by the Federal Water Quality Administration; and an economic study of marine solid wastes disposal, by the Massachusetts Institute of

¹ See Appendix A.

² See Appendix B.

Technology under contract to the National Council on Marine Resources and Engineering Development.

Sources of ocean dumping discussed in this report deserve definition:

- *Dredge spoils*—the solid materials removed from the bottom of water bodies generally for the purpose of improving navigation: sand, silt, clay, rock, and pollutants that have been deposited from municipal and industrial discharges.
- *Sewage sludge*—the solid material remaining after municipal waste water treatment: residual human wastes and other organic and inorganic wastes.
- *Solid waste*—more commonly called refuse, garbage, or trash—the material generated by residences; commercial, agricultural, and industrial establishments; hospitals and other institutions; and municipal operations: chiefly paper, food wastes, garden wastes, steel and glass containers, and other miscellaneous materials.
- *Industrial wastes*—acids; refinery, pesticide, and paper mill wastes; and assorted liquid wastes.
- *Construction and demolition debris*—masonry, tile, stone, plastic, wiring, piping, shingles, glass, cinderblock, tar, tarpaper, plaster, vegetation, and excavation dirt.
- *Radioactive wastes*—the liquid and solid wastes that result from processing of irradiated fuel elements, nuclear reactor operations, medical use of radioactive isotopes, and research activities and from equipment and containment vessels which become radioactive by induction.

In this report, the Council first summarizes its findings and recommendations for action to control ocean dumping. Chapter I inventories the sites, amounts, and composition of wastes dumped in the ocean and analyzes trends. The effects of these waste materials on the marine environment and man are outlined in Chapter II. Chapter III discusses alternatives to ocean dumping in terms of costs, availability, and effectiveness. The State and Federal agencies and authorities that deal with specific aspects of dumping are discussed in Chapter IV. Chapter V considers the international implications of ocean dumping.

Findings and Recommendations

THE Council on Environmental Quality concludes that there is a critical need for a national policy on ocean dumping. It is not a serious, nationwide problem now, but the decisions made by municipalities and industries in the next few years could lead to dramatic increases in the level of dumping. Once these decisions are made and ocean dumping proceeds, it will be costly and difficult to shift to land-based disposal at some future date.

Ocean-dumped wastes are heavily concentrated and contain materials that have a number of adverse effects. Many are toxic to human and marine life, deplete oxygen necessary to maintain the marine ecosystem, reduce populations of fish and other economic resources, and damage aesthetic values. In some areas, the environmental conditions created by ocean disposal of wastes are serious.

The Council study indicates that the volume of waste materials dumped in the ocean is growing rapidly. Because the capacity of land-based waste disposal sites is becoming exhausted in some coastal cities, communities are looking to the ocean as a dumping ground for their wastes. Faced with higher water quality standards, industries may also look to the ocean for disposal. The result could be a massive increase in the already growing level of ocean dumping. If this occurs, environmental deterioration will become widespread.

In most cases, feasible and economic land-based disposal methods are available for wastes currently being dumped in the ocean. In many cases, alternatives to ocean dumping can be applied positively for purposes such as land reclamation and recycling to recover valuable waste components.

Current regulatory activities and authorities are not adequate to handle the problem of ocean dumping. States do not exercise control over ocean dumping, and generally their authority extends only within the 3-mile territorial sea. The Army Corps of En-

gineers authority to regulate ocean dumping is also largely confined to the territorial sea. The Corps has responsibility to facilitate navigation, chiefly by dredging navigation channels. As such, it is in the position of regulating activities over which it also has operational responsibility. The Coast Guard enforces several Federal laws regarding pollution but has no direct authority to regulate ocean dumping. The authority of the Federal Water Quality Administration does not provide for issuance of permits to control ocean dumping. And the Atomic Energy Commission has authority only for disposal of radioactive materials. The Council believes that new legislative authority is necessary.

Finally, this report recognizes the international character of ocean dumping. Unilateral action by the United States can deal with only a part—although an important part—of the problem. Effective international action will be necessary if damage to the marine environment from ocean dumping is to be averted.

POLICY AND REGULATORY RECOMMENDATIONS

The Council on Environmental Quality recommends a comprehensive national policy on ocean dumping of wastes to ban unregulated ocean dumping of all materials and strictly limit ocean disposal of any materials harmful to the marine environment. In order to implement the policy, new regulatory authority is necessary. The Council on Environmental Quality recommends legislation that would:

- Require a permit from the Administrator of the Environmental Protection Agency for the transportation or dumping of all materials in the oceans, estuaries, and the Great Lakes.

- Authorize the Administrator to ban ocean dumping of specific materials and to designate safe sites.

- Establish penalties for violation of regulations.

- Provide for enforcement by the Coast Guard.

The Administrator of the Environmental Protection Agency would be guided by the following principles in exerting his authority:

- Ocean dumping of materials clearly identified as harmful to the marine environment or man should be stopped.

- When existing information on the effects of ocean dumping are inconclusive, yet the best indicators are that the materials could create adverse conditions if dumped, such dumping should be phased out. When further information conclusively proves that such dumping does not damage the environment, including cumulative and long-term damage, ocean dumping could be conducted under regulation.

The criteria for setting standards for disposing of materials in the ocean and for determining the urgency of eliminating disposal operations should include:

1. Present and future impact on the marine environment, human health, welfare, and aesthetics.

2. Irreversibility of the impact of dumping.

3. Volume and concentration of materials involved.

4. Location of disposal, i.e., depth and potential impact at one location relative to others.

- High priority should be given to protecting those portions of the marine environment which are biologically most active, namely the estuaries and the shallow, near-shore areas in which many marine organisms

breed or spawn. These biologically critical areas should be delimited and protected.

The Council on Environmental Quality recommends the following policies relating to specific types of wastes currently being dumped in the ocean, in estuaries, and in the Great Lakes:

- Ocean dumping of undigested sewage sludge should be stopped as soon as possible and no new sources allowed.

- Ocean dumping of digested or other stabilized sludge should be phased out and no new sources allowed. In cases in which substantial facilities and/or significant commitments exist, continued ocean dumping may be necessary until alternatives can be developed and implemented. But continued dumping should be considered an interim measure.

- Ocean dumping of ~~solid~~ sources of solid waste should be stopped as soon as possible. No new sources should be allowed, i.e., no dumping by any municipality that currently does not do so, nor any increase in the volume by existing municipalities.

Ocean dumping of polluted dredge spoils should be phased out as soon as alternatives can be employed. In the interim, dumping should minimize ecological damage. The current policy of the Corps of Engineers in designating highly polluted areas only when absolutely necessary should be continued, and even then, navigational benefits should be weighed carefully against damages.

The current policy of prohibiting ocean dumping of high-level radioactive wastes should be continued. Low-level liquid discharges to the ocean from vessels and land-based nuclear facilities are, and should continue to be, controlled by Federal regulations and international standards. The development of such standards should be continued. Ocean dumping of other

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No ocean dumping of chemical warfare materials should be permitted. Biological warfare materials have not been disposed of at sea and should not be in the future. Ocean disposal of explosive munitions should be terminated as soon as possible.

Ocean dumping of industrial wastes should be stopped as soon as possible. Ocean dumping of toxic industrial wastes should be terminated immediately, except in those cases in which no alternative offers less harm to man or the environment.

Ocean dumping of unpolluted dredge spoils, construction and demolition debris, and similar wastes which are inert and non-toxic should be regulated to prevent damage to estuarine and coastal areas.

Use of waste materials to rehabilitate or enhance the marine environment, as opposed to activities primarily aimed at waste disposal, should be conducted under controlled conditions. Such operations should be regulated, requiring proof by the applicant of no adverse effects on the marine environment, human health, safety, welfare, and amenities.

RESEARCH NEEDS

In the long term, additional information is required in the implementation of this policy. Serious information deficiencies exist, and research is required in the following major areas:

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Toxic materials should be identified and their lethal, sublethal and chronic long-term effects on marine life investigated. Information is needed on the persistence of toxic substances; how pollutants are degraded chemically and biologically; the effects of radioactivity on the marine environment and man; and the capacity of waters to assimilate waste materials.

More information is needed about public health risks from ocean pollution. Studies should determine what pathogens are transported in marine ecosystems and how. Better methods of measuring public health dangers are also needed.

Research is needed on the recycling of wastes and the development of alternatives to ocean dumping. Technical problems must be solved, but there is also a great need to study the social, institutional, and economic aspects of waste management.

Effective national and international monitoring systems need to be developed. Research is necessary to develop improved

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methods and technology so that alterations in the marine environment may be detected. But there is also a need for data coordination so that data gathering and analysis efforts are not duplicated.

SUMMARY

The Nation has an opportunity unique in his-

tory—the opportunity to act to prevent an environmental problem which otherwise will grow to a great magnitude. In the past, we have failed to recognize problems and to take corrective action before they became serious. The resulting signs of environmental degradation are all around us, and remedial actions heavily tax our resources. This is clearly the time for a conscious national decision to control ocean dumping.

RUSSELL E. TRAIN, *Chairman*
Robert Cahn
Gordon J. MacDonald

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Ocean Dumping: Location, Quantities, Composition, and Trends

ABOUT 48 million tons of wastes were dumped at sea in 1968. These wastes included dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid waste, explosives, chemical munitions, radioactive wastes, and miscellaneous materials. This chapter indicates rapid increases in ocean dumping activity over the last two decades and the potential for great increases in the future. At the same time, ocean dumping of wastes from other sources should decrease through implementation of water quality standards and new Federal laws dealing with control of sewage from vessels and with oil pollution.

DISPOSAL SITE LOCATIONS

Data on disposal sites are still incomplete, with little definitive information on sites off Alaska and Hawaii and outside the U.S. contiguous zone (more than 12 miles offshore). There are almost 250 disposal sites off U.S. coasts. Fifty percent are located off the Atlantic Coast, 28 percent off the Pacific Coast, and 22 percent in the Gulf of Mexico. Table 1 summarizes the number of sites for each major area and the number of permits issued for their use. The locations of the disposal sites are indicated in Figure 1.

TABLE 1.—*Ocean Dumping: Site Location
Summary (22, 66)*

Coastal area	Number of sites	Active Corps disposal permits
Atlantic Coast.....	122	136
Gulf Coast.....	56	80
Pacific Coast.....	66	71
Total.....	244	287

Not included in Table 1 are some 100 artificial reefs constructed by private concerns, under permits issued by the U.S. Army Corps of Engineers. (66) These reefs, sometimes formed of old car hulks or tires, are intended to provide artificial shelters for fish.

QUANTITIES AND TYPES OF WASTES

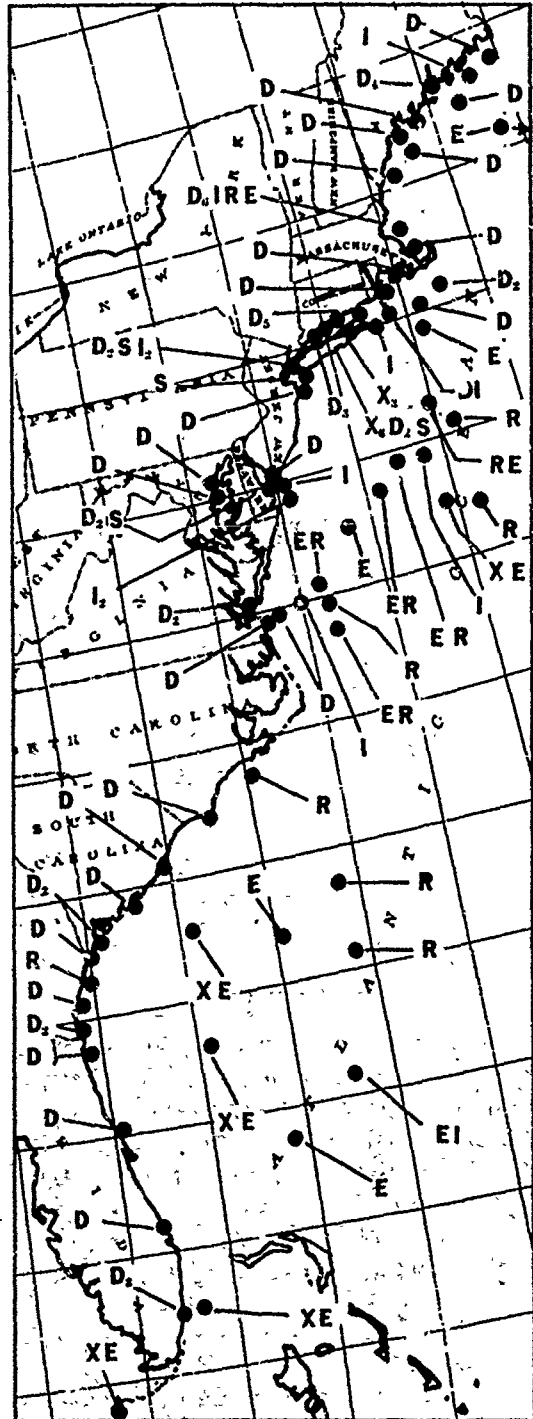
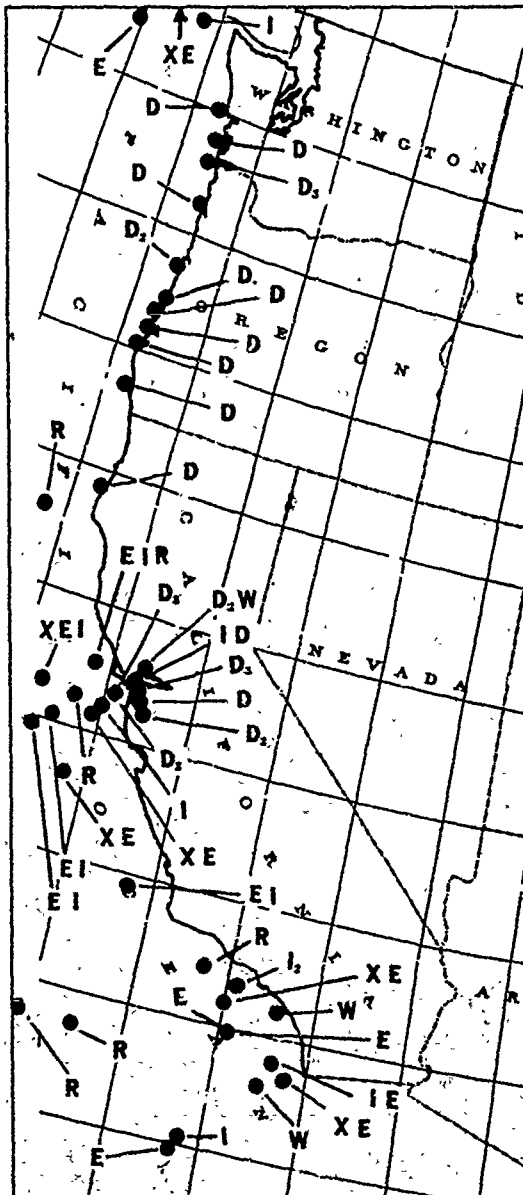
The categories of wastes covered in this report are used because of the large quantities of materials currently dumped, their potential for increase, or their special characteristics, such as toxicity. The quantities for each category are summarized by coastal region in Table 2. Radioactive wastes and chemical munitions are not included in the table because weight is not a meaningful descriptor. Each, however, will be discussed later.

The Bureau of Solid Waste Management estimates that the data in Table 2 represent about 90 percent of ocean dumping. However, the data undoubtedly underestimate the size and scope of the problem because of the time lapse and the possibility of many small community operations or illicit operations by private firms. Also not included in the table are those wastes that are piped to sea.

Each major category of ocean dumping sources is now discussed and the possible chemical composition of the wastes delineated as an aid in evaluating their present and potential effects on the marine environment.

Dredge Spoils

A large percentage of dredging is done directly by the Corps. The remainder is done by private contractor under Corps permit. Spoils are generally disposed of in open coastal waters less than 100 feet deep.



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Figure 1.—Known Dumping Sites Off U.S. Coasts (22, 66)

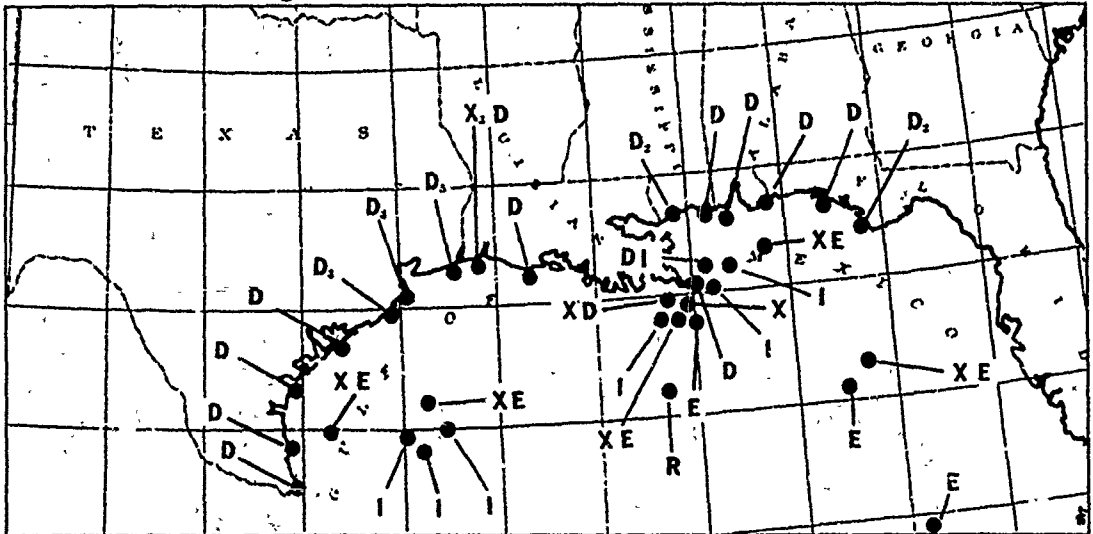


TABLE 2.—Ocean Dumping: Types and Amounts, 1968 (66)

(In tons)

Waste type	Atlantic	Gulf	Pacific	Total	Percent of total
Dredge spoils.....	15,808,000	15,300,000	7,330,000	38,438,000	80
Industrial wastes.....	3,913,200	868,000	981,300	4,860,800	10
Sewage sludge.....	4,477,000	0	0	4,477,000	9
Construction and demolition debris.....	574,000	0	0	574,000	<1
Solid waste.....	0	0	28,000	28,000	<1
Explosives.....	15,200	0	0	15,200	<1
Total.....	22,867,400	15,968,000	8,327,300	48,210,700	100

Dredge spoils account for 80 percent by weight of all ocean dumping. The Corps of Engineers estimates that about 34 percent (13 million tons) of this material is polluted. Contamination occurs from deposition of pollutants from industrial, municipal, agricultural, and other sources on the bottom of water bodies. The quantities of polluted dredge spoils are shown in Table 3.

Polluted dredge spoils vary at every location according to the land-based sources of pollution. Detailed quantitative analyses of the pollutants in dredge spoils in the coastal

TABLE 3.—Estimated Polluted Dredge Spoils (23)

Coastal area	Total spoils (in tons)	Estimated percent of total polluted spoils ¹	Total polluted spoils (in tons)
Atlantic Coast.....	15,808,000	45	7,120,000
Gulf Coast.....	15,300,000	31	4,740,000
Pacific Coast.....	7,330,000	19	1,380,000
Total.....	38,438,000	34	13,250,000

¹ Estimates of polluted dredge spoils consider chlorine demand; BOD; COD; volatile solids; oil and grease; concentrations of phosphorus, nitrogen, and iron; silica content; and color and odor of the spoils.

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areas are not available. An analysis by the Federal Water Quality Administration (FWQA) of polluted spoils from Lake Erie indicates that a total of 82,091 tons of spoils created 10,500 tons of chemical oxygen demand (COD). (23) These large quantities of oxygen-demanding materials can reduce the oxygen in the receiving waters to levels at which certain fish and other aquatic populations cannot survive. Also present were toxic heavy metals. Even with substantial dilution, the levels of heavy metals in the spoils may deleteriously affect marine life, as shown in Table 4.

TABLE 4.—Heavy Metals Concentrations in Dredge Spoils (23, 36)

(In parts per million)

Metal	Concentrations in dredge spoils	Natural concentrations in sea water	Concentrations toxic to marine life
Cadmium.....	130	.06	.01-10.0
Chromium.....	180	.00008	1.0
Lead.....	310	.00008	.1
Nickel.....	610	.0084	.1

Industrial Wastes

Industrial wastes were the second largest category of pollutants dumped at sea in 1968 (4.7 million tons, or 10 percent of the total). (66)

Most industrial wastes are commonly transported to sea in 1,000- to 5,000-ton-capacity barges. Sites are 4 to 125 miles off the Atlantic Coast, from 25 to 125 miles off the coast of the Gulf of Mexico, and from 5 to 75 miles off the Pacific Coast. Most of the sites are at the nearshore end of the range.

Highly toxic industrial wastes are sometimes contained in 55-gallon drums and are jettisoned from either merchant ships or disposal vessels at least 300 miles from shore. The containers are sometimes weighted and

sunk. More frequently, they are ruptured at the surface, either manually with axes or by small arms or rifle fire. (66)

The breakdown for disposal methods by geographic area is shown below.

TABLE 5.—Industrial Wastes by Method of Disposal (66)

(In tons)

Coastal area	Number of sites	Bulk wastes	Containerized wastes	Total
Atlantic Coast.....	10	3,011,000	2,200	3,013,200
Gulf Coast.....	6	690,000	8,000	698,000
Pacific Coast.....	7	961,000	300	961,300
Total.....	23	4,662,000	8,500	4,670,500

Table 6 shows the relative quantities of major industrial wastes found in a survey of 50 producers in 20 cities.

TABLE 6.—Industrial Wastes by Manufacturing Process (66)

Type of waste	Estimated tonnage	Percent
Waste acids.....	2,720,300	88
Refinery wastes.....	502,900	12
Pesticide wastes.....	226,300	7
Paper mill wastes.....	140,780	3
Other wastes.....	98,100	20

The types of contaminants in industrial wastes dumped at sea vary greatly because of the diversity of industries and production processes involved. Many of the wastes are toxic—some highly toxic. For example, refinery wastes, which are 12 percent of the total ocean-disposed industrial wastes, can include cyanides, heavy metals, mercaptides, and chlorinated hydrocarbons. Pulp and paper mill wastes may contain "black liquor" and various organic constituents which are toxic to the marine environment. Chemical manufacturing and laboratory wastes that are dumped include arsenical and mercuric compounds and other toxic chemicals. (66)

Sewage Sludge

Sewage sludge is the waste solid byproduct of municipal waste water treatment processes. These solids can be further treated by digestion, a process which allows accelerated decomposition of the sludge to control odors and pathogens. Most sewage sludge is disposed of on land or is incinerated. Relatively small amounts (4.5 million tons on a wet basis) are currently dumped at sea, of which almost 4.0 million tons are dumped off New York harbor. (66) As of 1968, there were no similar operations on either the Gulf or Pacific Coasts, although sludge is being discharged from Los Angeles by pipeline.

Sewage sludge in digested or undigested form contains significant quantities of heavy metals. A study by the FWQA indicated that copper, zinc, barium, manganese, and molybdenum are present in sewage sludge. (9) The concentrations and types of toxic materials vary because sludge is the residual of waste water treatment and contains whatever domestic and industrial contaminants have entered the system. Table 7 shows the minimum, average, and maximum values for three heavy metals found in one analysis of sewage sludge.

TABLE 7.—Heavy Metals Concentrations in Sewage Sludge (8, 9, 36)
(In parts per million)

Metal	Concentrations in sewage sludge			Natural concentrations in sea water	Concentrations toxic to marine life
	Min.	Avg.	Max.		
Copper.....	215	647	1,980	.006	.1
Zinc.....	1,380	2,480	3,700	.72	10.0
Manganese.....	30	262	790	.002	-----

Sewage sludge also contains significant amounts of oxygen demanding materials. In 1969, sludge dumped in the New York Bight, encompassing the New York harbor and

some adjacent coastal areas, had an oxygen demand of about 70,000 tons. (15) These wastes also include some bacteria that cause diseases in man.

Construction and Demolition Debris

Only New York City disposes of debris at sea in significant quantities because of the lack of nearby available landfill. Sea disposal is conducted with 3,000- to 5,000-ton capacity barges that are towed some 9 miles offshore. These materials are generally inert and non-toxic.

Solid Waste

Solid waste, the byproducts and discards of our society, amounts to approximately 5.5 pounds per capita per day collected by municipal and private agencies. (28) Although these wastes total approximately 190 million tons per year, ocean disposal accounted for only about 26,000 tons. (66) Ocean dumping of solid waste occurred exclusively on the Pacific Coast, where they were generated by cannery operations and commercial and naval shipping operations. Other sources no doubt exist, but the overall magnitude of the current problem is minor.

The composition of solid waste, ascertained by sampling, is shown in Table 8. It is presented here to indicate the materials that would be introduced into the marine environment if ocean dumping of solid waste becomes a common practice.)

Solid waste disposed of in the ocean interacts with the water, but the resultant chemical products are difficult to determine. Studies have been done on the interaction between solid waste and fresh water in sanitary landfills as the water percolates through the waste materials. (The resultant mixture of water and chemicals is called leachate.)

TABLE 8.—Composition of Solid Waste (25)

Type of waste	Average (percent)
Paper products.....	43.8
Food wastes.....	18.2
Metals.....	9.1
Glass and ceramics.....	9.0
Garden wastes.....	7.9
Rock, dirt, and ash.....	2.7
Plastics, rubber, and leather.....	2.1
Textiles.....	2.7
Wood.....	2.5
Total.....	100.0

The percentage of pollutants in solid waste is not nearly as high as in sewage sludge or dredge spoils, but it does contain nutrients, oxygen-demanding materials, and heavy metals. Laboratory studies of water contaminated by solid waste have shown significant quantities of heavy metals, with zinc, nickel, and magnesium present in concentrations of 13, 27, and 378 parts per million respectively. (29) These concentrations are well above toxic levels for marine life.

Up to 50 percent of solid waste is usually paper, wood, plastics, and rubber, all of which can float to the surface. Particularly significant are the plastics which will not become water soaked and will not degrade for many, perhaps even hundreds, of years. Even if baled before ocean disposal, it is almost certain that over time the bales will disintegrate and the floatables will rise to the surface. The potential esthetic problems of large quantities of solid wastes floating to the surface and then being carried to shore are staggering.

Explosives and Chemical Munitions

Unserviceable or obsolete shells, mines, solid rocket fuels, and chemical warfare agents have been disposed of in deep water for many years. In 1963, the Navy initiated Operation

"CHASE," in which munitions were disposed of by sinking them in obsolete hulks. Since then, 19 gutted World War II Liberty ships containing munitions have been scuttled. In the last six operations, the weapons were to detonate, but the S.S. ROBERT LOUIS STEVENSON failed to do so as planned and is located on the continental shelf near Alaska in 2,200 feet of water.

Since 1964 at least 18,342 tons of ammunition and explosives have been dumped in this manner. Additional cargoes of approximately 35,000 tons containing an unknown proportion of net explosives were also scuttled. A detailed listing of the ships scuttled, their cargoes, and disposition are shown in Table 9.

Detonation of explosives can result in trace amounts of lead, nickel, bronze, and other metals in the water, depending on corrosion processes and the materials used in the munitions.

Radioactive Wastes

Most nuclear waste products are liquid and of low radioactivity. They consist mostly of decontaminated process and cooling waters from reactors, fuel processing, and other operations. Small amounts of liquid wastes are highly radioactive; they result from the reprocessing of reactor fuel elements.

Solid radioactive wastes are produced by contamination of equipment and other materials during nuclear power plant operations, from medical use, and by research and development activities.

Solid radioactive wastes have been buried in carefully controlled landfill sites. Low-level liquid nuclear wastes are treated and/or stored to reduce radioactivity before disposal. High-level liquid wastes are stored exclusively in tanks at land-based sites.

TABLE 9.—Explosives and Chemical Munitions, 1964-1970 (30)

Year	Name	Total cargo (in tons)	Nature of cargo	Net explosives (in tons)	Disposition
1964	S.S. John F. Shafroth.....	8,798	A&E	Unknown	SDW
	S.S. Village.....	7,835	A&E	Unknown	SDW
1966	M.V. Coastal Mariner.....	4,040	A&E	512	D at 1,000'
	S.S. Santiago Iglesia.....	3,715	A&E	408	D at 1,000'
1966	S.S. Innes Van Zandt.....	7,800	A&E	1,026	D at 4,000'
	S.S. Hernes Grealy.....	6,083	A&E	442	D at 4,000'
1967	S.S. Robt. L. Stevenson.....	6,800	A&E	2,327	S
	S.S. Corporal Eric G. Gibson.....	9,005	Chem.	None	SDW
	S.S. Monahan.....	833	A&E	Unknown	SDW
1968	S.S. Mormacorn.....	7,788	Chem.	N.A.	SDW
	S.S. Richardson.....	7,457	A&C	138	SDW
1968	S.S. Cape Tryon.....	7,826	A&E	1,145	DU
	S.S. Cape Catoche.....	6,348	A&E	1,350	DU
	S.S. Cardinal O'Connell.....	6,431	A&E	2,144	DU
1970	S.S. Frederick E. Williamson.....	5,245	A&E	478	DU
	S.S. Cape Comfort.....	6,200	A&E	N.A.	DU
	S.S. Walker D. Hines.....	6,500	A&E	N.A.	DU
	S.S. David Hughes.....	5,000	A&E	N.A.	DU
	S.S. LeBaron Russell Briggs.....	2,064	Chem.	N.A.	SDW

Definitions: A&E=ammunition and explosives; N.A.=not available; DU=Detonated unintentionally; SDW=sunk in deep water; D=detonated; S=sunk at less than 4,000 feet and did not detonate

as planned; A&C=ammunition and cylinders contaminated with residues of GB nerve gas.

Liquid and solid radioactive wastes which have been dumped in the ocean are usually in concrete-filled metal drums or containers. Table 10 summarizes the amounts of these wastes disposed of at sea.

The quantities of radioactive materials disposed of at sea have decreased dramatically for several reasons. First, in 1960 the Atomic Energy Commission placed a moratorium on new licenses for disposal of radioactive wastes in the ocean. Only one commercial organization (which has never conducted any sea disposal), two Government agencies, and one university are still authorized to dispose of radioactive wastes in the ocean. Second, the major contractors of the AEC have not disposed of any wastes at sea since 1962. And for economic reasons, those firms with licenses

are phasing out sea disposal of radioactive wastes in favor of land disposal.

TABLE 10.—Radioactive Wastes: Historical Trends, 1946-1970 (70)

Year	Number of containers	Estimated activity at time of disposal (in curies)
1946.....		
1949.....	75,201	92,600
1951.....	4,087	275
1952.....	6,130	478
1953.....	129	8
1954.....	114	30
1955.....	24	5
1956.....	43	104
1957.....	12	62
1958.....	0	0
1959.....	25	28
1960.....	2	3
Total.....	86,785	94,673

Two sites have been used for disposal of most of the wastes in the Pacific Ocean. These sites are approximately 48 nautical miles west of the Golden Gate Bridge. One commercial firm has disposed of wastes in the Pacific Ocean farther than 150 miles from the U.S. coast; these disposals, 11 in number, were at depths greater than 6,000 feet. In the Atlantic Ocean, the major sites for disposal were in the area of Massachusetts Bay, approximately 12 to 15 miles from the coast; approximately 150 miles southeast of Sandy Hook, N.J.; and approximately 105 miles from Cape Henry, Va. With the exception of the Massachusetts Bay site, disposal was at depths greater than 6,000 feet. The Massachusetts Bay site was in 300 feet of water.

PAST TRENDS

Figure 2 shows significant increases in ocean dumping activities during the years 1951-1968. These data do not include dredge spoils or explosives because historical data could not be readily reconstructed. Radioactive wastes are also excluded because of their negligible weight contribution.

Table 11, on which Figure 2 is based, shows a fourfold increase in tonnage dumped at sea from 1949 to 1968. The 28 percent increase

between the 1959-1963 period and the 1964-1968 period is largely attributable to dramatic increases in industrial wastes and sewage sludge disposal. In 1959, industrial wastes disposed of at sea approximated 2.2 million tons. By 1968, the amount had increased to over 4.7 million tons, a 114 percent increase in 9 years. The amount of sewage sludge disposed of at sea increased by 61 percent in the same period, from 2.8 million tons to 4.5 million tons. (66)

FUTURE TRENDS

Assessing future trends in ocean dumping requires analysis of basic population trends. Population growth is accompanied not only by increased amounts of wastes but also by decreased space available for their disposal.

Between 1930 and 1960 the coastal population increased by 78 percent, compared with a 48 percent increase nationwide. (36) The figures below (25) indicate the population growth in the coastal region projected through the year 2000:

1960	57,946,000
1970	68,397,000
1980	76,607,000
1990	92,940,000
2000	106,900,000

TABLE 11.—Ocean Dumping: Historical Trends, 1949-1968¹ (66)

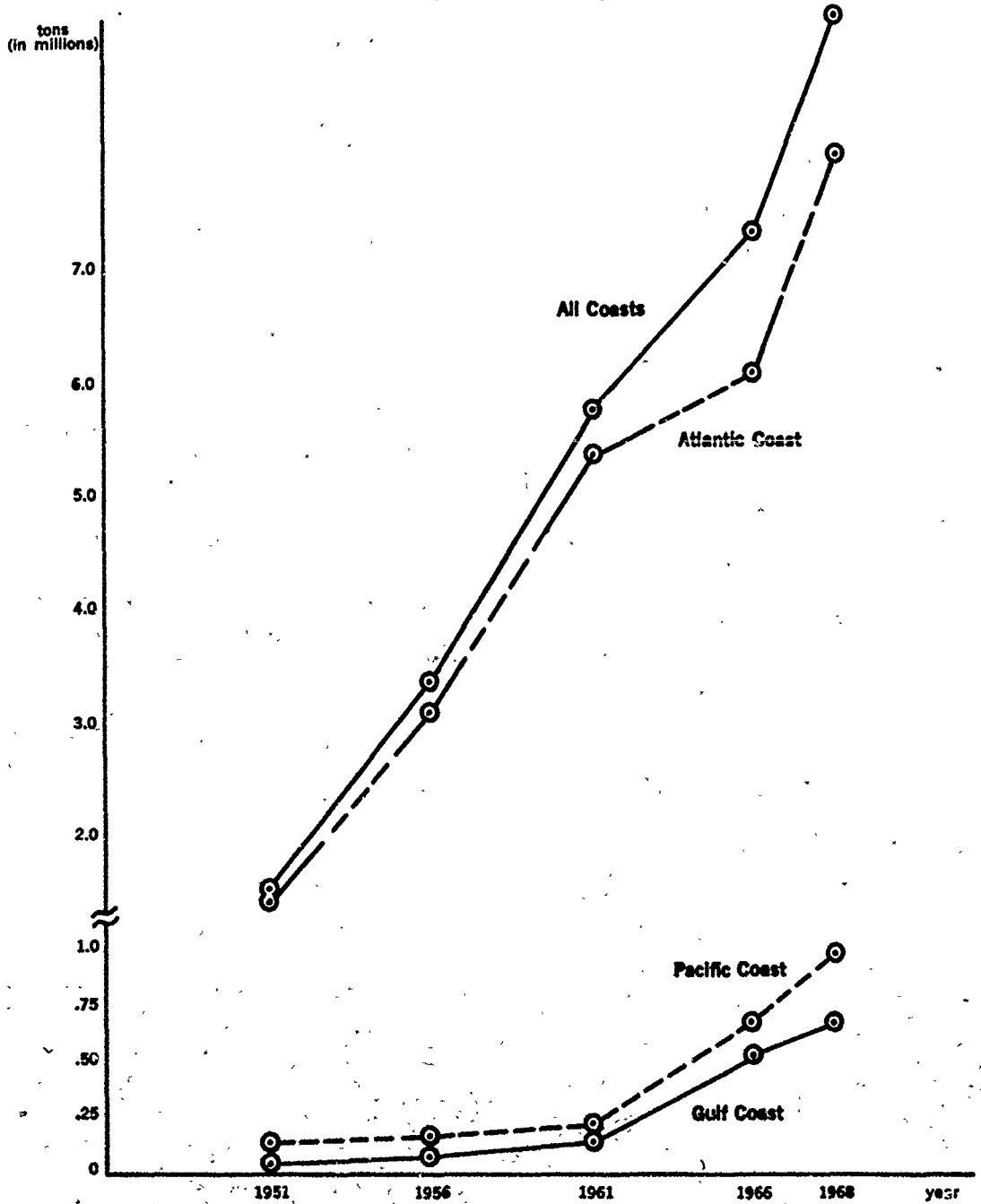
Coastal area	1949-1968		1964-1968		1960-1968		1964-1968	
	Total	Avg./Yr.	Total	Avg./Yr.	Total	Avg./Yr.	Total	Avg./Yr.
Atlantic Coast.....	8,400,000	1,600,000	16,000,000	3,200,000	27,270,000	5,454,000	31,100,000	6,220,000
Gulf Coast.....	40,000	8,000	263,000	53,000	360,000	172,000	2,600,000	520,000
Pacific Coast.....	457,000	97,000	830,000	170,000	940,000	188,000	2,410,000	482,000
Total.....	8,827,000	1,705,000	17,133,000	3,426,000	28,070,000	5,814,000	37,110,000	7,422,000

¹ Figures do not include dredge spoils, radioactive wastes, and military explosives.

² Estimated by fitting a linear trend line between data for preceding period and data for succeeding period....

³ Disposal operations in the Gulf of Mexico began in 1968.

Figure 2.—Average Annual Tonnage Dumped at Sea—
by Coastal Area (66)



Solid Waste

About 65 million tons of solid waste are generated annually in the coastal region. Based on a conservative estimate of 8 pounds of waste generated per person per day in the year 2000—the generation rate which will be reached by 1980—over 150 million tons will need to be disposed of for that one year. (28) If 10 pounds per person per day are generated, total wastes in the coastal area will be close to 200 million tons, more than triple current levels. The pressure to use the ocean for waste disposal will increase as land disposal sites become more scarce, costs increase, and metropolitan areas face political problems in obtaining new land disposal sites. Several cities are currently exploring the use of the ocean as a solid waste disposal site, and this interest is expected to increase. In some cases operations may begin within a year. If even a small percentage of the solid waste annually generated in the coastal area were disposed of at sea, the quantities entering the marine environment would be many orders of magnitude greater than all solid waste disposed of at sea to date.

Sewage Sludge

Based on an average of .119 pounds of sludge generated per person per day, potential sludge disposal quantities for the coastal region can be roughly estimated. (37) In 1970, approximately 1.4 million tons of sludge will be disposed of in the coastal areas, and in the year 2000, approximately 2.1 million tons will be generated, an increase of 50 percent in 30 years. If anything, these figures may underestimate future quantities of sludge. For example, between 1960 and 1980, 20-year period, the sludge generated by the Baltimore-Washington area is expected to increase from 70,000 tons to 166,000 tons, or about a 140 percent increase. New

York City's sludge barged to sea is expected to increase from 99,000 tons in 1960 to about 220,000 tons in 1980, a 120 percent increase in 20 years. (66)

Industrial Wastes

The volume of industrial production, which gives rise to waste production, is increasing at a rate of 4.5 percent annually, or three times the population growth rate. Additionally, the FWQA estimates that the manufacturing industry is responsible for three times as much waste as that produced by the Nation's population. And about 40 percent of the Nation's industrial activity is concentrated in the estuarine economic region. (36) Given increasingly stringent water quality standards and the ever expanding level of industrial waste generation in the coastal zone, the potential for increased industrial waste dumping at sea is great.

Radioactive Wastes

The amount of liquid and solid radioactive wastes will rise with projected increases in nuclear power generation. The amount of high-level liquid radioactive wastes will increase from 100,000 gallons in 1970 to 8,000,000 gallons by the year 2000 and radioactive solid wastes, from approximately 1 million cubic feet in 1970 to 3 million cubic feet by 1980. (70) As mentioned earlier, however, ocean dumping has been virtually nonexistent since the early 1960's because of the AEC moratorium and the economic advantage of land disposal.

Large radioactive structures, an additional source of radiation, are not yet a significant problem. In the past, the few that became obsolete have been decontaminated, dismantled, and kept under surveillance on land—with the exception of parts of one nuclear sub-

marine, which were disposed of in the ocean. Currently, however, there are 16 nuclear power plants in operation, 55 under construction, and 25 for which construction permit applications are pending with the Atomic Energy Commission. (70) If current forecasts are realized, by the year 2000, the equivalent of up to 1,000 nuclear power units, each with a capacity of some 1,000 megawatts, may be operating. In addition, the Navy has about 90 nuclear-powered submarines and surface ships, and many more may be built in the next 30 years as a large portion of the current naval fleet is replaced. Commercial nuclear ships—currently the N.S. SAVANNAH is the only one—may become economically feasible in the future.

A lifetime of 10 to 30 years for the power plants' and ships' reactor vessels is reasonable in terms of physical or technological obsolescence. Their radiation levels vary considerably, up to 50,000 curies of induced radiation in each structure. (70)

Individually none of these sources adds significant amounts of radioactivity to the ocean. Taken together, however, the increases could be of significant concern.

Dredge Spoils

In the long run, the reduction of polluted discharge from municipal and industrial sources, brought about by water quality standards, will lessen the problem from dredge spoils. However, they will remain a problem for at least the next 5 to 10 years. During this period, there will be pressures for more dredging to deal with increasing marine commerce, to meet the desire of cities

for new deep-water harbors, and to provide draft for larger vessels (including the super-tankers used to transport oil). These needs will all increase total dredging and hence dredge spoils.

Explosives and Chemical Munitions

The following are Department of Defense estimates of conventional munitions planned for disposal: in 1970, 103,777 tons; in 1971, 88,835 tons; and in 1972, 80,000 tons. (26) These quantities are several times larger than the total volume of these wastes disposed of at sea in the last two decades. They indicate the quantities which would enter the marine environment if no other disposal technique were employed.

Chemical munitions have also been disposed of at sea in three deep-water disposal operations, but actual quantities involved are not known. No future ocean disposal operations are planned. Biological agents have not previously been disposed of at sea, and no future disposal is projected.

SUMMARY

The data indicate that the volume of wastes dumped in the ocean is increasing rapidly. Many are harmful or toxic to marine life, hazardous to human health, and esthetically unattractive. In all likelihood, the volume of ocean-dumped wastes will increase greatly due to decreasing capacity of existing disposal facilities, lack of nearby land sites, higher costs, and political problems in acquiring new sites.

CHAPTER II deals with the effects of ocean dumping in terms of the broader problem of ocean pollution. This view is necessary because wastes affect marine ecosystems no matter where or how the pollutants originate and because pollutants tend to interact, sometimes synergistically, in the environment.

Marine pollution has seriously damaged the environment and endangered humans in some areas. Shellfish have been found to contain hepatitis, polio virus, and other pathogens; pollution has closed at least one-fifth of the Nation's commercial shellfish beds; beaches and bays have been closed to swimming and other recreational use; lifeless zones have been created in the marine environment; there have been heavy kills of fish and other organisms; and identifiable portions of the marine ecosystem have been profoundly changed.

THE PATHWAYS OF POLLUTION

In order to understand the effects of pollutants on marine ecosystems, one needs to understand how pollutants are dispersed and concentrated. The dispersal of wastes depends on the material involved. Most wastes, but far from all, sink to the bottom. Others, such as solid waste, oil, and garbage, contain many floatable materials. Floating wastes can be transported great distances by current and wind. Early in 1970, the Heyerdahl expedition countered wastes over large areas of water in mid-ocean, reporting that the ocean was "visibly polluted by human activity." (55)

Suspended materials, such as fine particles, are also transported by currents over great distances. For example, horizontal currents flush the 500 square miles of the New York Bight, completely exchanging the water in

less than 1 week. (42) Vertical movement is considerably slower, and pollutants may remain in layers of water for quite some time.

Pollutants enter living systems through biological concentration. Billions of tiny phytoplankton organisms act as a great biological blotter, picking up nutrients, trace metals, and other materials. Organisms feed on the phytoplankton and successively pass the pollutants on to higher organisms. As this process moves through the food chain, concentrations reach their highest levels in predators such as marine mammals, birds, and man. An example of the food chain may be seen in the North Atlantic—1,000 pounds of phytoplankton produces:

100 pounds of zooplankton or shellfish
50 pounds of anchovies and other small fish

10 pounds of the smaller carnivores

1 pound of the carnivores harvested by man. (41)

The concentration of chemicals by phytoplankton and subsequent further concentration within the food chain have lethal and sublethal effects on organisms.

Heavy metals have been found in toxic concentrations in plankton, seaweed, and shellfish, although levels of concentration in the surrounding water were not high. The ability of biota to concentrate materials varies from a few hundred to several hundred thousand times the concentrations in the surrounding environment. (8, 42, 48) Table 1 shows phytoplankton concentration factors for selected metals.

EFFECTS ON MARINE LIFE

Pollution affects marine life directly through toxicity, oxygen depletion, biostimulation, and habitat changes.

TABLE 1.—*Phytoplankton Concentration of Some Heavy Metals. (45)*

Metal	Concentration factor
Aluminum.....	100,000
Cobalt.....	1,500
Copper.....	20,000
Iron.....	45,000
Lead.....	40,000
Radium.....	12,000
Zinc.....	26,000

Toxicity

Although plants and animals are sometimes killed by toxic wastes, organisms may be affected by concentrations far below the lethal level. Sublethal effects include reduced vitality or growth, reproductive failure, and interference with sensory functions.

Copper was found in the waters of the New York Bight in concentrations greater than 0.120 milligrams per liter. (8) These concentrations, found throughout the water column, indicate widespread copper contamination.

With even lower concentrations of copper, laboratory experiments have shown that:

- Concentrations of 0.1 milligrams per liter killed soft clams in 10-12 days. (62)
- Concentrations of 0.05 milligrams per liter killed polychaete worms in 4 days. (63)
- Concentrations of 0.1 milligrams per liter inhibited photosynthesis in kelp 70 percent in 9 days. (16, 17)

Pesticides and other toxic materials are a major cause of fish kills in fresh water. Although there are few recorded fish kills in the ocean resulting from pesticides, pesticide concentrations are rising every year. They reduce the size and strength of mollusk shells. Reduced growth rate and reproductive activity in fishes exposed to sublethal doses of pesticides and copper have also been shown. (54)

Pesticides endanger higher predators because of biological concentration. For example, pesticides amplified through the food chain damage birds' reproductive capability and in some cases seriously reduce their populations. The peregrine falcon is the most dramatic example; pesticide accumulation through the food chain has led to drastic reduction and projected extinction in the co-terminous United States.

Oil introduced into the marine environment produces several adverse effects: Reproduction and other behavior is altered. Direct contact with respiratory organs weakens or kills animals. And oil clogs their filtering mechanisms. (67) Experiments with oysters have shown that when water-soluble fractions of oil were introduced into water, the amount of water filtered by the oysters decreased from between 207 and 310 liters per day to between 2.9 and 1.0 liters after 8 to 14 days. (18)

Cancer in fishes is very likely a result of contact with certain waste products. Cancerous growths on the lips of croakers have been found in areas of the Pacific Ocean polluted by oil refinery wastes. (65) Growth on several species including White Seabass and Dover Sole caught in oil polluted areas have been reported. (72) Oysters and barnacles are also known to concentrate cancer-producing agents.

Laboratory tests with "black liquor" from a paper mill showed that 0.05 grams per liter affected photosynthesis and 1 gram per liter killed the four species of phytoplankton tested. (66)

In laboratory experiments with polluted sediments from the New York Bight disposal area, the following sublethal effects were shown:

- Serious infections were found in native species.

- Bottom waters inhibited phytoplankton cell growth and division. (34)

Lethal and sublethal effects from toxic wastes are complex and not well understood. But evidence is mounting that these effects may be widespread and very harmful to the marine environment. Their potential for deferred and long-range ecological damage must be taken into account in any program to control ocean dumping.

Oxygen Depletion

Oxygen supports marine and aquatic life and is necessary to the biological degradation of organic materials. Organic wastes dumped or discharged into water bodies demand oxygen to decompose. If waste loads are too heavy, the oxygen levels become depleted and the diversity of marine organisms is altered.

Many of the Nation's rivers, estuaries, and harbors are in this condition. In the Potomac estuary, severely polluted by municipal wastes, dissolved oxygen levels approach zero in some reaches during low flow periods of warm summer months. (33)

When all the oxygen is depleted, organisms die, and anaerobic bacteria produce hydrogen sulfide and methane gas, which are malodorous. Large amounts of oxygen are required to decompose some materials. The dissolved oxygen in 320,000 gallons of air-saturated sea water is required to oxidize 1 gallon of crude oil completely. (64) If the oxygen level is already low, damage from oil spills may increase.

Dumping undigested sewage sludge in the ocean can create a significant demand on the dissolved oxygen. And oxygen depletion can develop rapidly. In the New York Bight waste disposal area, where sludge has been dumped for 40 years, the oxygen concentration as a percent of saturation declined from 61 percent in 1949 to 59 percent in 1964. It

then dropped to 29 percent in 1969 and was as low as 10 percent in the center of the dump. (42) This may indicate that a threshold was reached and that the water quality then deteriorated rapidly.

Oxygen levels fell below those necessary to sustain life in species of lobster and crab normally found in the area. Researchers have noted that:

the most striking effect observed was the *extreme depletion of dissolved oxygen* in the bottom waters over the disposal areas during the summer months. Levels frequently fell below 2 parts per million during the period from July to mid-September . . . This condition is undoubtedly caused by the heavy oxygen demand of the organic-rich waste materials coupled with the reduced mixing rates normally found during the summer. (43)

Oxygen deficit in a waste disposal area may be self-perpetuating. The accumulation of organic matter, sulfides, and some metals can act as a reservoir of future oxygen demand. Even after the disposal of the organic matter is stopped, it may be a long time before the area recovers.

Biostimulation

Some wastes, such as sewage sludge, are particularly rich in nutrients, such as phosphates and nitrates. These nutrients can cause bio-stimulation—the accelerated fertilization of plant life. When the plants die, oxygen necessary to support marine life is used in their decomposition. And when dead algae are carried to beaches, they rot and produce unpleasant odors.

By creating excessive blooms of algae, bio-stimulation indirectly changes the nature of bottom sediments and thus whole communities of bottom organisms. For example, areas

which formerly supported surf clams in sand may become covered with an algal mud to which the surf clams cannot adapt. Sediments adjacent to disposal areas show greatly increased concentrations of organic matter. Some come directly from the wastes, but other material filters down from algal blooms. (2)

In the past, biostimulation has been recognized as a major problem of fresh waters, but not of the oceans. Increasingly, however, biostimulation is affecting estuaries and bays and even some portions of the continental shelf.

Shock

Explosions from dumping of munitions cause death in marine organisms surrounding the explosion point. The Department of Defense calculates that detonation of 1,000 tons of explosives—the approximate amount contained in the September 4, 1970, "Deep Water Dump" off Washington State—generates a shock wave that will kill most marine animals within 1 mile of the explosion and will probably kill those fish with swim bladders out to 4 miles from the explosion.

Habitat Changes

Evidence indicates that waste disposal practices drastically alter certain marine communities. Habitat changes are the most common change that can affect entire ecosystems.

The most pronounced ecological changes, caused by dumping sewage sludge and polluted dredge spoils, have been found in the New York Bight. The consistency of bottom sediments changed from sand or hard mud to muddy ooze. Nematode worms, normally tolerant of pollution, were completely

¹A large group of fish with respiratory organs that adjust to different depths.

absent from the center of the dredge spoil dump and were found in very low numbers in the center of the sewage sludge dump. (2)

Changes in the kinds and quantities of sediments deposited may alter ecosystems. The plague of starfish in the Pacific may be an example of this effect. In recent years, the numbers of Crown of Thorns starfish have multiplied. This coral-eating starfish has devastated large areas of the coral reefs off many Pacific islands and the Great Barrier Reef of Australia. The population explosion may be linked to sediment protecting the larval starfish from their predators, which normally keep the population in balance. The sediment results from blasting, dredging, and dumping.

Significant changes in the benthic ecology of the Southern California coast have been caused by wastes from several municipalities. (11) These wastes brought about a shift in the marine population. Large numbers of sea urchins replaced other organisms and grazed off most of the giant kelp beds near the sewer outfalls. Because of the commercial value of giant kelp and the habitat it provides for many marine animals, the changes were an economic and an ecologic loss.

Habitat changes may be quite subtle. Near a sewer outfall off San Diego, species variety declined an average of 30 percent. Populations of remaining species sometimes overran their food supply. The loss of species diversity made the ecosystem less stable. (71)

HUMAN IMPACTS

Public health problems are created by toxic agents and pathogens that find their way into the human food chain through seafood. Floating refuse and surface films reduce recreation opportunities and damage esthetic values. Economic losses are incurred when seafood

species are killed or are rendered inedible by pollution.

Public Health

The standard method for determining the potential public health hazard of fish is the coliform bacteria count. (These harmless bacteria are rough indicators of pathogens.) If the count exceeds Food and Drug Administration (FDA) standards, shellfish beds are closed to harvesting.

Effluents from land-based sewage outfalls are the major source of coliform bacteria, but ocean dumping of sewage sludge is also significant. The FDA found that ocean bottom sediments up to 6 miles from the New York Bight sludge dump contained coliform counts that exceeded permissible levels. On May 1, 1970, this area, 12 miles in diameter, and a similar area off Delaware Bay were closed to shellfishing. Clams harvested for sale in the New York Bight contained coliform bacteria 50 to 80 times higher than the standards set by FDA. (2)

Hepatitis virus are carried by shellfish. A 1961 outbreak of infectious hepatitis was traced to raw shellfish taken from Raritan Bay, N.J. (36) Shellfish have been collected with polio virus concentrated to at least 60 times that of surrounding waters. (52)

White perch have become actively infected with human pathogens by exposure to human wastes, and they may transmit these pathogens over considerable distances. Exposure is sufficient for them to develop antibodies to such human diseases as pseudo-tuberculosis, paratyphoid fever, bacillary dysentery, and a variety of chronic infections. (40)

Aquatic and marine organisms are capable of concentrating radioactivity to high levels (45). In a study near Oak Ridge National Laboratory, dead embryos and abnormalities appeared in irradiated broods of killifish.

This is the only example of a natural marine or aquatic population subjected to high-level irradiation over many generations. (68)

Hydrocarbons of the type known to cause cancer in man and animals are concentrated by oysters and mussels in polluted areas. These substances remain invisible and odorless in seafood tissues, even after frying. (28) Cancer in humans has not yet been traced to consumption of carcinogens from seafood, but public health officials do not discount the possibility.

Between 1953 and 1960, 111 persons were reported to have been killed or to have suffered serious neurological damage near Minamata, Japan, as a result of eating fish and shellfish caught in areas contaminated by mercury. Among these were 19 congenitally defective babies whose mothers had eaten the fish and shellfish. Subsequently, at Niigata 26 more cases of mercury poisoning were noted. (1) The fish eaten by the affected Japanese contained from 5 to 20 parts per million of methyl mercury.

Mercury pollution recently discovered in 33 States and in Canada caused many fishing areas to be closed. Concentrations of as high as 5 parts per million have been found in fish in the Great Lakes. (1)

Loss of Amenities

The coastal zones provide recreation and beauty for the 60 percent of the Nation's people dwelling there. Oceans afford swimming, boating, water skiing, sport fishing, and wildlife viewing opportunities,² and they are some of the most scenic areas of the United States.

Many beaches have been closed to swimming because of the high coliform content of the water. Most closed beaches are near large

² The Bureau of Sport Fisheries and Wildlife estimates that as many as 100 million people observe the wildlife of the U.S. estuarine zone.

metropolitan areas, such as San Francisco and New York. Floating materials, such as solid waste and oil, pose a major threat to amenity values. Rotting algae and anaerobic waters cause unpleasant odors and visual pollution. And debris are often a hazard to small boats.

Economic Loss

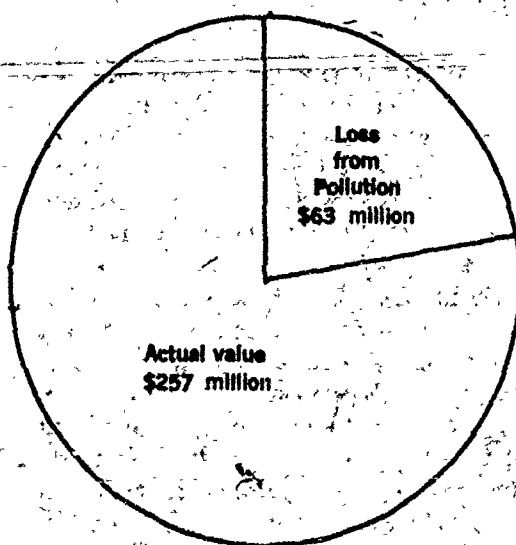
Significant economic losses result from ocean pollution. A major loss is the commercially valuable fish or other seafood species killed directly or indirectly or rendered inedible. They represent serious social and financial losses because of the near subsistence level of many fishermen.

In 1969, the total catch of crabs, lobsters, shrimp, oysters, clams, and scallops was 729 million pounds. Because one-fifth of the Nation's 10 million acres of shellfish beds are closed due to contamination, it can be estimated that the total catch would have been 181 million pounds higher. This estimate is probably low, since the closed areas are particularly productive—in lush estuarine systems in close proximity to large cities where they would have been harvested intensively. Figure 1 indicates the financial impact assuming a loss of one-fifth the potential catch.

The loss is well documented in San Francisco Bay. (36) Prior to 1935, the annual commercial harvest of soft shell clams was between 100,000 and 300,000 pounds. Today clam-digging is virtually nonexistent because of pollution. The annual commercial landings of the shrimp fishery prior to 1936 were as high as 6.5 million pounds; landings in 1965 were only 10,000 pounds.

Contamination by pesticides or mercury has rendered nine species of fish unfit for consumption by humans. Many States have

Figure 1.
Potential Value of U.S. Shellfish Catch, 1969
\$320 million



banned fishing and impounded fish because of mercury poisoning, and the FDA impounded coho salmon due to high levels of DDT.

Even where contaminant levels do not prevent safe consumption, the food may be discolored or tainted. Sludge decay can result in the production of hydrogen sulfide, which blackens the shells of clams and oysters and affects their taste and odor. (36) In even very small amounts, oil can taint the flesh of fish. The discharge residue from burning 2.6 gallons of a gasoline-oil mixture in an outboard motor was sufficient to taint fish in 1 acre-foot of water. (37)

A further ocean dumping cost is that of cleaning up or rehabilitating polluted beaches and other shores. If projected increases in solid waste are dumped at sea, continuous and expensive clean-up operations will be required.

SUMMARY

The information presented in this chapter is necessarily incomplete. Knowledge of ocean pollution is rudimentary, and generally it has not been possible to separate the effects of ocean dumping from the broader issue of

ocean pollution. Yet one general conclusion is apparent: There is reason for significant concern. Dealing with ocean pollution requires that all sources be greatly reduced. If no action is taken and ocean dumping continues to increase, the long-term damage to the marine environment will be great.

THE critical or potentially critical sources of ocean pollution and their effects on the marine environment are described in Chapters I and II. Based on these findings, a strong national policy has been recommended to stop or limit ocean dumping substantially. The extent to which the recommended policy can now be implemented depends on existing alternatives for handling wastes.

This chapter sets forth alternatives, both interim and longer term. The interim alternatives discussed are practical, available disposal techniques which can be used now to reduce or prevent damage to the marine environment without shifting the problem to another part of the environment. Long-term alternatives look toward recycling, resource conservation, and more economic and environmentally safe techniques of waste management. Costs and capacity are estimated to indicate the impact of the alternatives.

The types of wastes for which alternatives are presented include: solid waste, sewage sludge, dredge spoils, industrial wastes, construction and demolition debris, radioactive wastes, and explosive and chemical munitions.

Although dredge spoils and industrial wastes are the two largest sources of ocean dumping, solid waste is discussed first because the alternatives are largely applicable to the other wastes dumped in the ocean.

SOLID WASTE

The amount of solid waste dumped in the ocean is not yet significant, less than 1 percent of all wastes disposed of in the ocean. Only about 26,000 tons were dumped in the ocean in 1968, (66) compared to the 190 million tons of municipal solid waste collected and dis-

posed of on land. (28) However, many communities are beginning to look to the ocean as a place to dispose of solid waste in light of increasing population; increasing per capita rates of solid waste generation; and the declining capacity, increasing costs, and lack of nearby land disposal sites. If many coastal cities were to dump solid waste in the ocean, many millions of tons would be introduced annually into the marine environment. Although little research has been done on how solid waste affects marine ecology, it is known that improper disposal of solid waste on land seriously contaminates ground water. Further, floating materials from the solid waste dumped in the ocean would be unattractive, especially when carried to shore. Accordingly, the policy recommended would prohibit new sources of solid waste in the ocean and call for phasing out existing sources.

Interim Alternatives

(Nationwide, landfill capacity is generally adequate. The average time remaining for currently used landfills in all metropolitan areas is 16 years, although some large metropolitan areas will soon exhaust their current sites. (28) Only 10 percent of land disposal operations are sanitary landfills, in which the wastes are covered daily by soil. The other 90 percent are open dumps, which create many health and esthetic problems. Rodents and insects breed and carry infectious diseases, and ground water often becomes polluted. Esthetically, open dumps are unattractive and malodorous. Converting open dumps to sanitary landfills can be accomplished relatively quickly and inexpensively.

There are two alternatives to ocean dumping of solid waste. New sites can be developed, but often at a considerably increased distance. Or incinerators can be constructed. By reducing the volume, possibly up to 90

¹Includes residential, commercial, industrial, institutional, and agricultural solid wastes.

percent, they can prolong the use of existing sites by many years.

The barriers to acquiring new sites are political and financial. Communities are reluctant to be the dumping ground for the wastes of large metropolitan areas, and transport to distant sites increases costs. Transfer stations and rail or transfer truck operations make these longer hauls more costly than collection vehicles traveling only a few miles to the disposal area. But they provide more flexibility in site selection. The barriers to the construction of new incinerators are largely financial. They are expensive to build and to operate. More stringent air pollution standards will add to both capital and operating costs.

Comparative costs for various alternative methods of disposal are shown in Table 1. As it indicates, the additional costs for use of rail haul and land disposal instead of ocean dumping are not so high when the distances are comparable. For example, when the wastes are transported 50 or 100 miles by either method, the costs of land disposal are less than 10 percent higher.

If conducted correctly, rail haul and land disposal offer an economically attractive method of disposing of solid waste. However, the political problems are a significant bar-

rier to a good economic and environmental solution. A stronger regional approach to waste management, better disposal operations, and adequate payment for the use of land could well overcome these barriers.

One possible alternative deals with the problems of both solid waste disposal and abandoned strip mines. Because of the small incremental costs involved in rail haul, large coastal cities could haul their wastes to these mines economically.

Available acreage within range of the three coastal areas has been estimated. In the mid-Atlantic States of Ohio, Pennsylvania, West Virginia, Virginia, New York, and New Jersey, over 660,000 acres of unreclaimed surface-mined land are available. Over 300,000 additional unreclaimed acres are available in the Gulf Coast States, Texas, Alabama, Mississippi, Louisiana, and Florida. On the West Coast, California and Nevada have approximately 150,000 acres of available, unreclaimed surface-mined land.

Nationwide, surface mining has disturbed over 3.2 million acres of land. The Department of the Interior estimates that over two-thirds of this acreage is completely unreclaimed. This 2 million acres represents 3,200 square miles of potential solid waste disposal sites. (31)

TABLE 1.—Comparison of Estimated Solid Waste Disposal Costs (28, 47)

(On a cost-per-ton basis)

Unit process	Sanitary landfill at nearby site	Incineration at central city site	Rail haul and landfill			Barge and ocean dumping			Incineration ship-based
			25 mi.	50 mi.	100 mi.	25 mi.	50 mi.	100 mi.	
Collection	\$15.00	\$14.00	\$14.00	\$14.00	\$14.00	\$14.00	\$14.00	\$14.00	\$14.00
Transfer operation	0	0	1.00	1.00	1.00	4.50	4.50	4.50	0
Haul	0	0	2.00	2.00	2.00	1.50	1.50	1.50	0
Disposal	1.25	22.50	0	0	0	0	0	0	10.00
Total	16.25	36.50	21.35	21.70	22.15	18.00	18.50	22.45	24.00

* Higher cost of collection for nearby landfill due to lack of central city site.

* Higher cost of ocean barge due to higher security requirements.

* Lower cost of landfill operation due to barge.

These figures do not consider suitability of terrain, amount of cover material, volume in need of fill, or other limiting factors. Nevertheless, there are access roads and rail lines to almost all this land, and if legal and social barriers can be removed, the problems both of providing large disposal areas and of reclaiming the land would be solved.

Containerizing wastes—that is, enclosing them in plastic or other material to prevent interaction with the sea—raises a number of potential problems. First, any containment system will still allow leaching of the wastes, some of which are toxic. Second, containment systems will probably not isolate the wastes from the ocean environment indefinitely. Plastics and other floatables are likely to be released eventually. As indicated in Table 1, the economics of containerizing wastes are not significantly better than for land disposal, assuming that solid waste would have to be dumped some distance from shore.

Ship-based incineration has also been suggested as an alternative disposal technique. It appears, however, to have little economic or environmental advantage. As Table 1 indicates, the costs are higher than for rail haul or land-based incineration. And difficulties of systematically locating and using sea dump sites may be a problem compounded by the difficulties of operating during bad weather. Further, many of the materials are noncombustible, and the effects of large amounts of ash residue on the ocean environment are not clearly known.

Longer-Term Alternatives

Although ship-based incineration may not be practical, other advances in incineration may have long-term benefits for solid waste man-

agement. A new type of incinerator, the CPU-400, is being developed under a Bureau of Solid Waste Management contract. Shredded and dried refuse is burned in a fluidized bed reactor to produce gas for turboelectric power generation. A 400-ton-per-day modular unit will produce up to 16,000 kilowatts of electric power. Total annual cost is projected at between \$4.27 per ton for a municipal utility and \$5.99 per ton for private ownership; the difference is a function of the interest rate. (18) (Current incineration costs are \$10.50 per ton.) Depending on revenues from the sale of electricity and residue byproducts, the net cost could be reduced. Soon in the pilot plant stage, this incinerator may provide a low-cost, environmentally sound method of dealing with solid waste.

Recycling may also become general practice. Technology exists to recycle many types of paper, glass, aluminum, and ferrous metals, among others. Currently, 19 percent of the materials used to manufacture paper products in the United States are recycled rather than virgin materials. (28) Eighty-five percent of all automobiles taken out of service are recycled and used in steelmaking, and tires and aluminum cans are beginning to be recycled. (28) The problems and associated costs of separation; transportation; poor secondary markets; and other legal, economic, and social barriers have limited recycling. However, with new approaches to these barriers, new technology, and the need to conserve resources, recycling may become practical on a broad scale in the future. And as more materials are reused, disposal needs will lessen. It is important to note that inexpensive but environmentally unsound practices such as ocean dumping discourage waste reuse and recycling, which are desirable in the long term.

SEWAGE SLUDGE

In 1968, about 200,000 tons of sewage sludge on a dry basis were disposed of at sea, compared to about 3 million tons disposed of by other means. Increasing population and the higher levels of treatment required to meet water quality standards will generate even more sludge. Given the difficulties of sludge disposal and the high costs involved, pressures to use the oceans will necessarily increase. The environmental problems from sludge disposal in the ocean are significant, in terms both of volume and of the toxic and sometimes pathogenic materials involved. Accordingly, the policy recommended would phase out ocean disposal of sewage sludge and prevent new sources.

Alternatives (Interim and Longer Term)

Sewage sludge is primarily disposed of by using it as a soil conditioner or landfill and, to a much lesser degree, by incineration. The costs of present ocean disposal operations are generally far below costs for land-based disposal. Ocean disposal a few miles from shore costs an average \$1 per ton. (66) Table 2 contains more detailed data on the per-ton-mile costs for longer hauls.

TABLE 2.—*Barge Haul Costs for Sewage Sludge Disposal (\$)*

City	Distance (miles)	Cost per ton-mile	Cost per ton
New York City.....	25	\$0.20	\$7.50
Elizabeth, Md.....	30	.25	9.00
Baltimore, Md.....	200	.05	10.00
Philadelphia, Pa.....	120	.04	12.00

Depending on distance, actual barge haul costs range from \$1 to \$12 per ton. Thickening, a process preparatory to barging, can add \$2 to \$6. Digestion can raise total ocean

disposal costs by \$5 to \$18 per ton. Total ocean dumping costs can range from \$3 for undigested sludge deposited nearshore to perhaps \$40 per ton for digested sludge dumped several hundred miles offshore. The current average is low because most communities that use the ocean for disposal dump undigested sludge nearshore. Table 3 summarizes costs for land and ocean disposal of sewage sludge.

TABLE 3.—*Estimated Costs of Land-Based Sewage Sludge Disposal (\$7, \$9)*

Location	Method	Cost per ton
Land.....	Digestion and lagoon storage (Chicago)....	\$45
	Digestion and land disposal.....	25
	Composting.....	\$5-15
	Processing into granular fertilizer (not cost).....	\$5-30
	High temperature incineration.....	\$5-60
Ocean.....	Barging undigested sludge.....	\$-15
	Barging digested sludge.....	\$-30
	Piping disposal.....	\$3-50

¹ At Chicago, with a 7-mile pipeline to the land disposal site.

These data indicate that land-based sewage sludge disposal is more expensive than near-shore ocean disposal. But when sewage is digested and barged a distance from shore, the costs become comparable, and land-based disposal may even be cheaper. As indicated in the discussion on solid waste disposal alternatives, the capacity does exist to handle more sewage sludge. But current land-based operations are often not adequate to protect the environment.

Pipeline disposal of treated sewage sludge, used by Los Angeles, has been proposed for other areas. Because piped and barged sludge materials are the same, the same policy is recommended. Further, the potential savings for piping are not significant in light of the potential environmental impact.

Piping digested sewage sludge 7 miles from Los Angeles costs an estimated \$1.55

per-ton. (37) FWQA estimates that current costs on the East Coast would double the net cost function of both increasing costs since the Los Angeles pipeline was constructed and the higher construction costs on the East Coast. Costs for longer pipelines to limit environmental damage would increase at a linear rate, and perhaps even faster, as the distance increased because of construction and pumping difficulties. A 80-mile pipeline might raise the cost to \$12 per ton and a 50-mile pipeline to perhaps \$20 to \$30 per ton.

More promising is the use of digested sludge for land and strip mine reclamation and for a supplemental crop fertilizer. As discussed earlier, many strip mines are in need of reclamation. Sewage sludge is high in nutrient value and can be used to improve lands low in organic matter.

The Metropolitan Sanitation District of Chicago has intensively researched the environmental impact and potential of using digested sewage sludge as a crop fertilizer and in land reclamation. Their studies document the nutrient value, lack of odor, and safety when used on all types of land, including clay, sand, and acid strip mine tailings. Depending on crops and soil condition, other nutrients may be needed, but the sludge can supply much of the needed nutrients and moisture. Chicago now spends over \$20 million annually to dispose of 900 tons (on a dry weight basis) of sewage sludge per day, using incineration, lagoon storage, and other methods. (50) The District is prepared to initiate a program of rail or barge haul for sludge disposal and land reclamation within a year. The program should cost approximately the same amount as current operations and has potential for large savings if pipe transport becomes feasible. Use of sludge for land reclamation looks promising, but it must be carefully controlled and monitored to assure no environmental harm.

In this discussion of land-based sewage sludge disposal, the alternatives to ocean dumping do not involve significantly greater costs. However, a phase-out period is required because of substantial commitments by some communities and the lead time necessary to develop the alternatives.

DREDGE SPOILS

Disposal of dredge spoils—38 million tons—represents 80 percent of all ocean dumping in 1968. (66) Removed primarily to improve navigation, spoils are usually redeposited only a few miles away. About one-third is highly polluted from industrial and municipal wastes deposited on the bottom. (22) Their disposal at sea can be a serious source of ocean pollution. The recommended policy to phase out ocean disposal of polluted dredge spoils recognizes that the speed of implementation depends almost entirely on available alternatives.

Interim Alternatives

Disposing of all dredge spoils on land is not possible simply because of the vast tonnage. The Corps of Engineers estimates that of the total dredge spoils removed from each coastal region, 45 percent, or approximately 7,120,000 tons, on the Atlantic Coast are polluted; 31 percent, or 4,740,000 tons, on the Gulf Coast, are polluted; and 19 percent, or 1,390,000 tons, on the Pacific Coast are polluted.

Until land-based disposal facilities can handle these quantities, the following interim operational techniques are recommended: First, the pollutant level of dredge spoils should be determined by sampling and analysis for such key factors as BOD and concentration of heavy metals. If the spoils are not polluted, they can be disposed of in the ocean.

However, care must be taken in the location of disposal sites and in the method of disposal in order to minimize turbidity and to protect marine life.

For polluted dredge spoils, current disposal practices are not adequate, but mitigation of damage to the environment is possible without recourse to sophisticated and/or expensive processing techniques. The estimated cost increases for hauling polluted spoils farther from the dredging site are presented in Table 4.

TABLE 4.—Estimated Dredging Costs Per Cubic Yard (24)

Method	1 mile	3 miles	10 miles	20 miles	50 miles
Hydraulic pipeline dredging.....	\$0.95	\$1.30	(1)	(1)	(1)
Dipper dredging and dump scows.....	1.10	1.25	\$1.50	\$1.80	\$3.60
Hopper dredging.....	0.28	0.34	0.54	0.81	1.66

¹ Pipeline dredging operations beyond 3 miles are usually not practical because of problems in handling long floating pipelines and the extra pumping equipment involved.

Most spoils are now deposited within a few miles from shore in less than 100 feet of water. Table 5 summarizes the additional costs for disposing of polluted dredge spoils farther out to sea using a hopper dredge.

As the table indicates, the additional cost for dumping polluted dredge spoils 10 miles rather than 3 miles out is \$2.7 million annually. For 20 miles, the additional cost is \$6.2 million; for 50 miles, it is \$17.5 million.

Diking is another interim alternative for disposing of polluted dredge spoils. Briefly, a

dike is constructed to hold the dredge spoils nearshore or at the shoreline. Its effectiveness depends on the prevention of contaminated spoils' interaction with surrounding waters. At Cleveland, diking was successful in containing over 99 percent of the contaminants in dredge spoils removed from Lake Erie. (23)

Estimates for 35 dike projects on the Great Lakes indicated that the costs of diking and depositing dredge spoils vary greatly—from \$0.35 to over \$6 per cubic yard. (23) The increased cost for disposal by diking over open-lake disposal ranged from \$0.03 to almost \$5.50 per cubic yard, with an average increase of \$1.50 per cubic yard.

Diking is not without environmental problems. Dredge spoils would not provide fill of sufficient strength to allow use of the diked area for many years. Hence, areas of the coastal zone, already in high demand, would be unusable. Further, diking is unattractive and may cause greater environmental problems than controlled dispersal of pollutants.

Longer-Term Alternatives

Reduction in the volume of sediments requiring dredging and higher levels of treatment of wastes will both lessen the problem of polluted dredge spoils. Erosion control through improved construction, highway, forest, and farm planning and management will reduce future dredging needs. One example is the recently completed stream bank stabilization project on the Buffalo River,

TABLE 5.—Estimated Costs for Disposal of Polluted Spoils Using Hopper Dredge

Coastal area	Tons	3 miles	10 miles	20 miles	50 miles
Atlantic Coast.....	7,120,000	\$2,521,000	\$3,845,000	\$5,767,000	\$11,819,000
Gulf Coast.....	4,740,000	1,612,000	2,560,000	3,839,000	7,368,000
Pacific Coast.....	1,300,000	473,000	751,000	1,126,000	2,307,000
Total.....	13,260,000	4,606,000	7,156,000	10,732,000	21,994,000

which reduced maintenance dredging requirements 40 percent. (23) The level of pollution in dredge spoils will be reduced by the higher levels of treatment of municipal and industrial wastes required by Federal-State water quality standards within a few years.

High-temperature incineration of contaminated dredge spoils is a longer-term alternative requiring further development and testing. Such incineration can render spoils an inert ash, safe for land disposal. Processing costs are a function of the size of the plant, the percent of total solids, and the percent of volatile solids. Figure 1 illustrates disposal costs per cubic yard for incinerating

dredge spoils whose total solid content ranges between 30 percent and 45 percent (a normal range) and volatile solids between 10 percent and 20 percent (a normal range). Also shown are costs for aerobic stabilization, a process similar to that used for sewage treatment. These costs can range from \$4 to \$12 per cubic yard or roughly 4 to 24 times current ocean disposal costs. Compared to disposal 20 miles out to sea, however, incineration is 3 to 15 times as costly. But compared to disposal at 50 miles, incineration may cost the same or it may be as much as 8 times more costly.

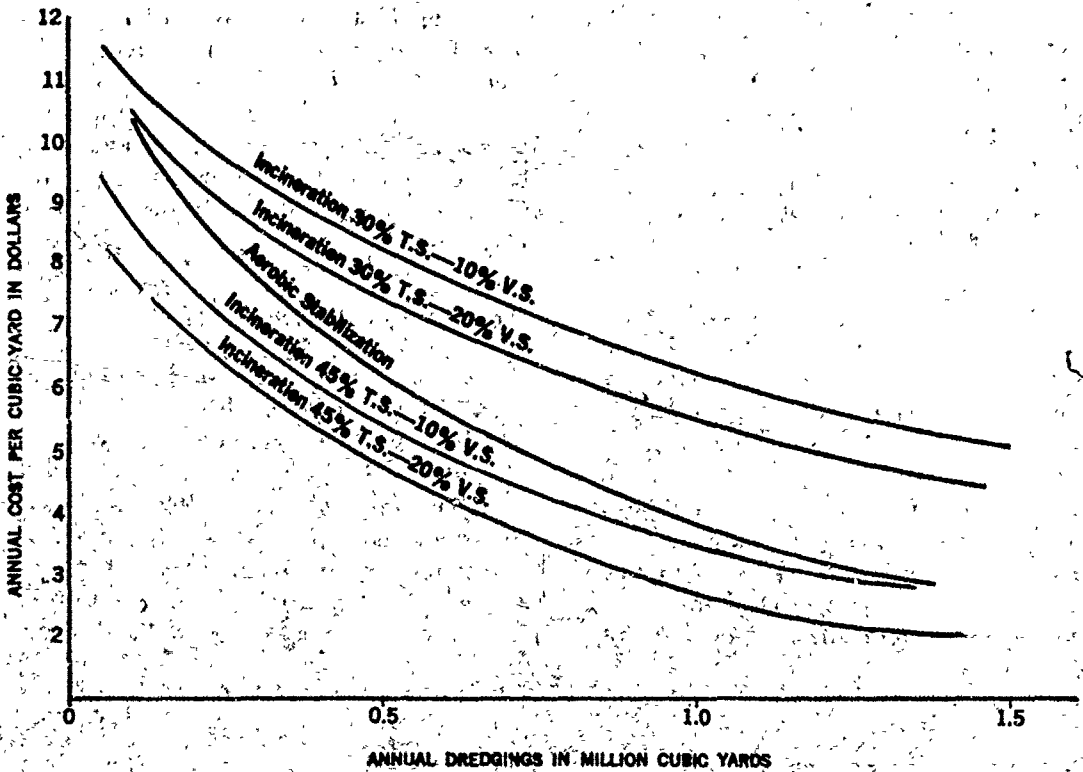


Figure 1.—Total Annual Cost Per Cubic Yard for Complete Treatment Using Incineration and Aerobic Stabilization. (23)

T.S.—TOTAL SOLIDS

V.S.—VOLATILE SOLIDS

Special treatment to remove toxic materials so that the sludge may be used as a fertilizer either on arid lands or for ocean farming is possible. An approach similar to that discussed for use of digested sewage sludge as a fertilizer may be feasible.

INDUSTRIAL WASTES

Industrial wastes vary widely, but they usually contain nutrients, heavy metals, and/or other substances toxic to marine biota. Although the volume of industrial wastes is 10 percent of all wastes disposed of in the ocean, it is minor compared to the quantities of industrial wastes treated at land-based facilities.

The policy recommended would call for termination of ocean dumping of industrial wastes as soon as possible. Ocean dumping of toxic industrial wastes should be terminated immediately, except in those cases in which no alternative offers less harm to man or the environment.

Interim Alternatives

Many industries utilize ocean disposal because it is cheaper and easier than other disposal processes. Table 6 shows costs for bulk and containerized wastes.

TABLE 6.—Industrial Wastes Disposal Costs (66)

Method	Average cost/ton	Range of cost/ton
Bulk wastes.....	\$1.70	\$0.00-\$9.50
Containerized wastes.....	24.00	\$5-\$130

The costs of discharging bulk wastes directly into the sea are significantly lower than for other disposal techniques. Contain-

erization, used mainly for toxic materials, is much more costly than dumping bulk wastes.

Industrial wastes can be treated and disposed of on land, or they can be incinerated. Whichever technique is used, it is necessary to assure that the environment is protected. Treatment of wastes should not add to stream pollution, and incineration should not add to air pollution. Deep-well disposal of toxic wastes is generally undesirable because of the danger of ground water pollution.

Unlike the other categories discussed, industrial wastes are not homogeneous. Hence, interim disposal methods will vary not only among the different types of wastes but also according to process, location, local practices, and other factors. The costs of using some alternatives will be significantly higher than for ocean dumping, but as a portion of total production costs, generally they will not be great. Total industrial pollution control costs, as a percentage of gross sales, are well under 1 percent, although costs for some industries are much higher.

Longer-Term Alternatives

In the long term, changes in industrial production processes and recycling offer great promise for reducing or reusing industrial wastes. For example, the average waste from modern sulfate paper plants is only 7 percent of wastes in the older sulfite process. In some cases, recycling will be an alternative to ocean disposal. Two West Coast refineries are now recycling oil wastes instead of disposing of them at sea.

Toxic wastes present a more difficult problem. They cannot be stored indefinitely, but allowing ocean disposal is a disincentive to development of adequate detoxification and recycling techniques and of production processes with fewer toxic byproducts. But highly toxic wastes will continue to be produced,

and many will not be amenable to land disposal.

One alternative worthy of further study is the establishment of regional disposal, treatment, and control facilities. Federally or privately operated, the facilities could conduct research on and provide for waste detoxification and storage. Complicated disposal processes that are too expensive or complex for a single company could be used jointly to dispose of wastes. Fees would need to be sufficiently high to encourage development of private solutions, except in the most troublesome cases or when significant economies would result from shared use of facilities.

CONSTRUCTION AND DEMOLITION DEBRIS

Construction and demolition debris, less than 1 percent of all wastes dumped in the ocean, (66) are composed mainly of dense and inert materials. Because of the small amounts dumped and their character, these wastes are not a threat to the marine environment. Moreover, amounts dumped in the ocean are not expected to increase significantly because of their high value as landfill. The recommended policy assumes continued ocean dumping, but with care to prevent damage to the marine ecosystem.

RADIOACTIVE WASTES

Since 1962, no significant quantities of radioactive wastes have been dumped at sea. Rather, they have been stored at several sites operated or regulated by the Atomic Energy Commission or at sites regulated by the States. Increasing demands for electricity and for use of nuclear power portend a dramatic

increase in the amounts and kinds of nuclear wastes produced. Hence, it is important to develop policy to prevent contamination of the ocean.

The policy recommended would continue the practice of prohibiting high-level radioactive wastes in the ocean. Dumping other radioactive materials would be prohibited, except in a very few cases for which no practical alternative offers less risk to man and his environment.

Alternatives (Interim and Longer Term)

The quantity of nuclear wastes is not large, and the technology for storing and treating them is well developed. However, the AEC estimates that the amount of high-level liquid radioactive wastes will increase approximately sixtyfold between 1970 and the year 2000. High-level wastes, usually liquid, are now stored on an interim basis in large, well-shielded tanks. In the long run, the wastes will be solidified, reducing their volume by a factor of ten, for eventual storage in special geological formations, such as salt mines. As new nuclear facilities are constructed, provision is being made for parallel construction of storage tanks and treatment facilities to handle the wastes.

Solid radioactive wastes have been buried in carefully controlled landfill sites. In 1970, about 40,000 cubic yards of solid radioactive wastes will be buried in approximately 15 acres. (70) The increase in the amount of these wastes in the next decade will require about 300 acres. This figure could be reduced with compaction and incineration, which are currently being used or planned.

Low-level liquid wastes from nuclear power generation, medical facilities, etc. are treated and/or stored to reduce radioactivity. A small amount is eventually released to the environment under controlled conditions.

Large radioactive structures, chiefly reactor vessels and associated parts, have heretofore not presented a significant problem. With the exception of ocean disposal of the SEA-WOLF submarine reactor vessel, obsolete reactor vessels and associated parts have been decontaminated, dismantled, and stored on land. Sixteen nuclear power plants are now operating, and 80 are either under construction or permit applications are pending. There may be as many as 1,000 plants by the year 2000. When reactor vessels are taken out of service, each used structure is a source of high-level induced radiation.

There are three alternative ways to dispose of these vessels and associated parts: ocean disposal; entombment in place, with final disposition after radioactive decay; and dismantling and burial. Ocean disposal is the cheapest method when the facility is on the coast or when waterborne transportation is available. Entombment provides an opportunity to monitor disposal operations carefully but occupies valuable land during the period of radioactive decay. Dismantling and burial is the most expensive of the alternatives.

Because of the need to keep all sources of radioactivity at the lowest possible level, ocean disposal of the wastes should be avoided except when no alternative offers less harm to man or the environment. These cases should be carefully examined to assure that no safe and practical alternatives do exist. If ocean disposal is necessary, it should be carefully controlled.

EXPLOSIVES AND CHEMICAL MUNITIONS

Large quantities of explosives and some chemical warfare agents have been disposed of at sea. No biological warfare agents have been

disposed of at sea. The policy recommended would prohibit ocean disposal of chemical and biological warfare agents and phase out disposal of explosive munitions.

Alternatives (Interim and Longer Term)

Ocean disposal of munitions was developed as an alternative to burning them in the open. That practice is often hazardous, is noisy, and creates air pollution.

Other alternatives to ocean dumping are available and should be used. In some cases weapons can be dismantled and critical components, such as gunpowder, lead, etc., either disposed of safely or sold for reuse. Centralizing the disposal of obsolete munitions may be desirable to provide efficient dismantling. Alternatively, portable disposal facilities, under development by the Department of Defense, offer promise. When salvage value is significant, commercial contracting for disposal services may be possible. Mass underground burial or detonation is another alternative.

The alternatives used for disposal of munitions will depend on ability to train people for disposal operations, relative costs, available sites, and their environmental impact. Dismantling and recycling the materials is the preferable alternative from an environmental point of view, but facility and manpower constraints may dictate the use of other alternatives to ocean dumping.

For chemical warfare agents and munitions, the alternatives to ocean disposal are neutralization and incineration. Toxic chemical warfare agents can be separated from munitions or containers and then treated. Facilities are currently being modified at the Rocky Mountain Arsenal near Denver, Colo., for disposal of toxins. Similar facilities for treatment of chemical warfare agents are needed elsewhere. (26)

SUMMARY

Interim alternatives exist to mitigate the environmental damage of ocean dumping. Land capacity can be expanded by use of rail haul, and strip mines and other lands can be reclaimed. In the long run, technological ad-

vances and new methods of recycling should help reduce pressures for ocean disposal. The major conclusion is that a program of phasing out all harmful forms of ocean dumping and prohibiting new sources is feasible without greatly increased costs.

Legislative Control of Ocean Dumping

THE previous chapters indicate the need for a national policy to control ocean dumping. This chapter examines the adequacy of State and Federal regulatory authorities to implement that policy.

STATE CONTROL ACTIVITIES

Although by tradition and Federal law the States have primary responsibility for water pollution control, the response of the coastal States to ocean dumping has not been extensive. Where the Federal Government has assumed authority over ocean dumping—in New York, Baltimore, Boston, and Hampton Roads, Va.—States have subordinated their activities to Federal control.

In some circumstances States exercise regulatory authority. California, for example, through State and regional agencies, has provided the leading role in control of ocean dumping of such materials as municipal garbage and industrial chemicals and solid waste. In the San Francisco Bay area and in the San Diego area, regional water quality control boards regulate ocean dumping operations and provide for monitoring and surveillance to enforce the regulations. Disposal operators are required to file detailed trip reports and a monthly summary of the volume and types of wastes dumped. In the San Diego area, prior notification of ocean dumping is required so that a board staff member can accompany the dumping vessel. In the Los Angeles area, the California Department of Fish and Game is the lead agency. In Oregon, the State Board of Health regulates ocean dumping, with special emphasis on chemicals. No other States regulate ocean dumping to a greater extent than California and Oregon.

State regulation has not established a basis for an extensive and comprehensive meth-

od of controlling ocean dumping. Besides general lack of authority and programs, State jurisdiction would generally be limited to the 3-mile territorial sea.

FEDERAL CONTROL ACTIVITIES

Four Federal agencies have some responsibilities for ocean dumping: the Corps of Engineers, the Federal Water Quality Administration, the Atomic Energy Commission, and the Coast Guard.

Corps of Engineers

The Corps of Engineers is the only agency with regulatory authority to control dumping of a broad class of materials. This authority stems from Corps responsibility for maintaining navigation in U.S. territorial waters. In general, the Corps has no power other than in internal navigable waters and in the territorial sea.

Special authority for the port areas of New York, Baltimore, and Hampton Roads, Va., was given to the Corps of Engineers under the Supervisory Harbors Act of 1888 (33 U.S.C. 441-451b). Under that Act, the Corps exerts jurisdiction over ocean dumping beyond the territorial sea by controlling transit through the territorial sea. The Act provides for the appointment of a harbor supervisor to control ocean dumping, authorizing him to issue permits for the transportation and dumping of materials into the ocean. For ocean dumping in territorial seas, the Corps relies on both section 4 of the Rivers and Harbors Act of 1905 (33 U.S.C. 419) and section 13 of the Rivers and Harbors Act of 1890 (33 U.S.C. 407). Through the regulatory and permit authority conferred by the Supervisory Act, logs and fathometer charts are required of tugboat operators

transporting material for dumping to provide surveillance of their operations. Infrequent ship and aircraft patrols are made for the same purpose. The permit operation has three steps: application by the prospective dumper according to the type of waste, issuance or rejection of a permit by the Corps after review, and monitoring of operations by the Corps as waste materials are transported to the designated dumping grounds.

The Corps has cautiously exercised its power under the 1899 and 1905 Acts. Its policy on enforcing these authorities can be attributed largely to emphasis on navigation in the enabling statutes. Until recently there was considerable doubt whether the Corps could deny a permit to a prospective waste disposal applicant for any reason other than obstruction to navigation. These doubts were dispelled only on July 16, 1970, when, in *Zabel v. Tabb*, — F. 2d — (5th Cir.), a Federal circuit court reversed a district court ruling. The district court disputed Corps authority to consider environmental as well as navigational factors in denying a permit and directed that the permit be granted. The circuit court, relying on the Fish and Wildlife Coordination Act (16 U.S.C. 661-666c) and the National Environmental Policy Act of 1969 (42 U.S.C. 4331-4347), held that the Corps does have this authority and could deny the permit.

Despite jurisdictional limitations, the Corps has occasionally concurred in ocean dumping outside the territorial seas when its direction was requested. For example, dumping areas have been established off Boston Harbor by the Corps, but with full recognition that authority was lacking. In such instances the action is taken at the request of the user. Often when the Corps receives a request to dump in areas beyond the territorial sea, it simply issues a letter of no objection. Prior to issuing such a letter, the Corps consults other governmental agencies

such as the Fish and Wildlife Service of the Department of the Interior and the fish and game department of the affected State.

In the New York Bight area, the Corps has designated areas for the deposit of rock, dredged material other than rock, cellar dirt, sewage sludge, chemicals, and other substances. Specific regulations define the areas in which dumping can take place. Special permits, usually of 3 months' duration, are issued for the transit of material to the dumping areas.

Criminal penalties are authorized to punish violations of the various Corps authorities. Fines of up to \$2,500 may be levied, or imprisonment up to 1 year may be imposed. Under the Supervisory Harbors Act, when dredged matter is illegally dumped, a fine of \$5 per cubic yard of material can be prescribed.

Corps authority over ocean dumping has several limitations: First, with the exception of three harbors, it is restricted to the 3-mile territorial sea; yet most waste disposal sites lie outside the territorial sea. Second, its authority originates from responsibility for the navigability of waterways, not for their ecology. Third, while operational authority is lodged in an agency with responsibility to promote navigation, the water quality agency has no direct control over actions of the operating agency. In fact, the Corps could conceivably issue permits for activities that FWQA believes damage the quality of marine waters. Fourth, to a large extent the Corps regulates itself because it is a major producer of dredge spoils, the material most commonly dumped at sea. This is the type of conflict of interest that the creation of the Environmental Protection Agency was designed to prevent. Nonetheless, the Corps has capabilities which could be effectively used to implement the recommended policy on ocean dumping. It possesses a large field organization strategically located in areas

where ocean dumping regulatory action is important.

Federal Water Quality Administration

The Federal Water Quality Administration (FWQA), in the Department of the Interior, administers section 10 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466g). Under this section, States develop water quality standards for interstate and coastal waters within their jurisdiction. The standards require Federal approval, thus becoming joint Federal-State standards.

These standards consist of water quality criteria (e.g., 5 parts per million of dissolved oxygen) to meet designated water uses (e.g., water supply, recreation, etc.). The standards must also include an enforcement and implementation plan in which remedial measures are to be taken in accordance with a schedule for achieving the water quality levels established. The Federal Water Pollution Control Act provides procedures for abating pollution which violates water quality standards, endangers health or welfare, or interferes with the marketing of shellfish in interstate commerce.

The Administration has proposed amendments to the Federal Water Pollution Control Act (S. 3471) that would authorize the Secretary of the Interior to establish water quality standards for the contiguous zone when pollution in these waters is likely to cause pollution in the territorial sea and to set standards for discharge beyond the contiguous zone of substances transported from territory under U.S. jurisdiction. The legislation would also call for specific effluent discharge requirements for all discharges into waters covered under the Act.

The authority of FWQA under the Federal Water Pollution Control Act, even with

the proposed new amendments, would not be adequate to control ocean dumping. First, there is no authority for requiring permits to dump wastes in the oceans—authority essential to enforcement of any effective control program. Second, the Act's general thrust is control of continuous discharges that clearly violate the water quality standards, rather than control of intermittent dumping.

Other sections of the Federal Water Pollution Control Act deal with ocean disposal of specific materials or classes of materials. Section 11 of the Act prohibits discharge of harmful quantities of oil into the navigable waters of the United States and the contiguous zone, but it deals only with oil and is aimed chiefly at spills, rather than at purposeful dumping.

Section 12 of the Act provides authority for Federal agencies to clean up and to prevent discharge of hazardous substances into the navigable waters of the United States and the contiguous zone. Hazardous substances are those that present an imminent and substantial danger to the public health and welfare. Many materials now dumped in the oceans could be classified as hazardous: solid waste containing heavy metals, DDT, or other persistent pesticides and sewage sludge from limited-treatment facilities. But regulating intentional ocean disposal of materials is beyond the scope of section 12.

Section 13 of the Act provides for control of sewage from vessels, chiefly by requiring the installation of marine sanitation devices.

Although FWQA lacks authority for issuing permits to control ocean dumping, it has several related responsibilities. These include approval, and in some circumstances establishment, of water quality standards in interstate and coastal waters; enforcement; research; technical assistance; monitoring; and other water quality functions.

Atomic Energy Commission

The Atomic Energy Act of 1954 authorizes the AEC to regulate the receipt, transfer, and possession of nuclear source, byproduct, and special materials (42 U.S.C. 2077, 2092, 2111); these include most radioactive substances. In addition, the AEC has authority to regulate and control contractually the use of radioactive materials for its own activities, such as AEC-supported research and development programs. These authorities cover ocean disposal of radioactive materials but not other wastes.

Coast Guard

The Coast Guard is the principal maritime law enforcement agency. It enforces or assists in the enforcement of all Federal laws on the high seas and waters subject to the jurisdiction of the United States and has authority to make inspections, searches, seizures, and arrests. In addition, the Coast Guard can assist other Federal agencies and State and local governments in carrying out their responsibilities. The Coast Guard's law enforcement capability can be an effective means of enforcing controls and standards set by other agencies, but it has no independent authority to control ocean dumping.

RECOMMENDATIONS

Authority to control ocean dumping is currently dispersed among several agencies. Jurisdiction is generally confined to the territorial sea, where most material is currently not dumped. Authority that is now used for control is not lodged in agencies responsible

for environmental control. Conflicts of interest exist in that some regulatory powers are exercised by agencies with operational responsibilities in the same area.

These problems must be resolved before a national policy on ocean dumping can be implemented. Full regulatory responsibility—involving both setting standards and issuing permits—should be placed in one organization. The Council recommends that this agency be the Environmental Protection Agency.

The organization charged with implementation of the national policy should have as its chief purpose the protection of the environment. It should also command sufficient research and monitoring resources for evaluating the environmental effects of the broad spectrum of materials currently dumped in the oceans.

Authority to control ocean dumping must be tied closely to efforts to abate other sources of pollution in the marine environment. Municipal and industrial discharge in rivers and harbors, urban and rural runoff, and other sources are important components of marine pollution. A regulatory program for ocean dumping should be defined to complement the efforts in these other areas.

Most of the wastes now dumped in the oceans originate in the United States and are transported to sea for dumping. Accordingly, primary jurisdictional emphasis should shift from a territorial basis to regulation of the transportation of materials from the United States for dumping.

The Environmental Protection Agency will have the broad responsibility as well as the necessary supporting programs to protect the marine environment. To give it the power to regulate ocean dumping, legislation is required.

International Aspects of Ocean Disposal

THE oceans of the world are a truly international resource, forming a vast environmental system through which its components circulate or are dispersed by currents and the migrations of organisms. They are critical to maintaining the world's environment, contributing to the oxygen-carbon dioxide balance in the atmosphere, affecting global climate, and providing the base for the world's hydrologic system.

Within the oceans, fish may travel great distances during their lifetimes. Although the oceans are important to all nations, they are particularly significant for many developing countries, which increasingly depend on fisheries for essential protein. A disturbance in the chemistry of the oceans which could be multiplied in the food chains would have a major impact on food-deficient nations. Hence, pollutants from one country may ultimately affect the interests of many other nations.

WORLDWIDE CHEMISTRY OF THE OCEANS

Of the materials entering the oceans through natural processes, the amounts of two, mercury and lead, have probably been doubled by man's activities. In addition, man has introduced new chemical compounds, such as chlorinated hydrocarbons (including DDT), gasoline, dry cleaning solvents, and other organic materials, whose biological significance is unknown.

The rate of transfer of mercury from land to oceans by natural weathering is estimated at 5,000 tons per day. (38) This amount, about one-half the total world production of mercury, is used by agriculture and industry in such a way that it eventually enters the oceans. As yet, this approximate doubling has not been chemically measured, but it is

thought responsible for the 10 to 20 times increase in mercury found in sea birds off Sweden between prewar years and the 1950's (5) and for additions to the high mercury content of fish off Japan.

Natural weathering introduces into the oceans about 150,000 tons of lead each year. Man introduces about 250,000 tons in the Northern Hemisphere alone (69). Most of this lead is derived from the washout into the oceans of atmospheric lead produced by burning gasoline enriched with tetraethyl lead. Industrial waste products further contribute lead. Over the last 45 years these additions have raised the average lead content of ocean surface waters from 0.01-0.02 to 0.07 micrograms per kilogram of sea water. (19) Slow mixing within the oceans keeps the lead within the upper layers, the region where biological productivity is greatest and the chances of biological enrichment highest. However, the biological effects of this changing lead concentration remain unknown.

Industrial wastes and sewage sludge also introduce large quantities of such metals as vanadium, cadmium, zinc, and arsenic. Man's contribution relative to nature's is not known, but civilization may well be close to matching nature's contribution of these materials to the oceans.

The fact that man is changing the chemical composition of the oceans focuses attention on the need for international action to control the introduction of wastes into the ocean.

INTERNATIONAL LAW ON WASTE DISPOSAL

In an environmental sense there are no subdivisions within the oceans. The highly productive coastal waters are continuous with and contribute to the biologic activity of the deepest trenches. Legally, the oceans are di-

vided into the seabed and the superjacent waters, and further subdivided into distinct zones with particular legal characteristics. International law governing ocean waste disposal must take into account these legal characteristics and the material to be dumped.

Four conventions, referred to as The Law of the Sea Conventions, were adopted at Geneva in 1958 codifying existing international law and establishing new rules governing the law of the sea. The Convention on the Territorial Sea and the Contiguous Zone sets out three zones—the territorial sea, the high seas, and the contiguous zone between them.

Narrow bays, estuaries, and other semi-enclosed areas are classed as internal waters. Seaward of the internal waters and of the low-water line along uninterrupted coasts is the territorial sea, extending for 3 miles. Between 3 and 12 miles from the shore is the contiguous zone. The contiguous zone, together with the waters lying seaward of it, comprise the high seas. Each has distinct legal characteristics affecting rights to dispose of materials in it and to control such disposal.

A coastal state (nation) has exclusive control over its internal waters and its territorial sea. In these areas, the coastal state has exclusive power to determine dumping sites and to enact necessary sanitary and pollution laws to protect its citizens and their property. These laws can be enforced against ships of both the coastal state and of foreign registry. In addition, a coastal state may control the transport of waste products from its ports. However, in its territorial sea, the coastal state must permit the innocent passage of foreign vessels that do not prejudice its peace, good order, or security. As discussed in Chapter IV, Congress has enacted legislation that covers ocean disposal of oil and sewage wastes from vessels.

Within the contiguous zone, 3 to 12 miles out to sea, the coastal state may exercise some control necessary to prevent pollution. The right to exercise these controls in the contiguous zone, however, does not change the high seas status of those waters. Under the terms of the Convention on the Territorial Sea and the Contiguous Zone, a coastal state cannot act to prevent dumping in the contiguous zone unless such action is necessary to prevent infringement of sanitary regulations within its territorial sea.

The international law governing the high seas, the largest jurisdictional zone, is codified in the 1958 Geneva Convention on the High Seas. This Convention provides for freedom of navigation and of fishing, freedom to lay submarine cables and pipelines, freedom to fly over the high seas, and other freedoms recognized by international law, such as dumping.

The Convention sets forth two fundamental concepts: It declares the high seas as an area not subject to sovereignty, and it states that the freedoms of the seas which are recognized in international law must be exercised by states with reasonable regard to the interests of all other states in their exercise of freedom of the high seas. Inasmuch as one use may interfere with another current or potential use of the high seas, the reasonable regard standard holds that there must be an accommodation of the various and possibly conflicting uses of the high seas.

The right to dispose of waste materials in the high seas is a traditional freedom of the seas. However, under the standards set out in the Geneva Convention on the High Seas, this freedom—like all other freedoms of the seas—must be exercised with reasonable regard to other states' use of the oceans. It is not possible to say that any particular waste disposal or dumping project will meet the requirements of international law. Only after careful consideration can it be determined

that a particular ocean dumping proposal meets the reasonable regard standard set out in the Convention. For example, a project for disposal of unpolluted dredge spoil may be suitable for an area of the high seas in which disposal of chemical waste would neither be suitable nor legal.

Unfortunately, the law of the sea conventions do not establish a hierarchy of ocean uses. However, international law places paramount importance on the protection of human life. It allows destruction of property to save human life or to prevent greater property damage. Clearly, any dumping activity that threatens life or directly damages property violates international law.

It is important to recognize that the law of the sea is based primarily on conventions or other agreements which were concluded prior to current understanding of the actual and potential impacts of dumping on the marine environment. Consequently, present international law appears inadequate to deal with possible long-term environmental effects of various actions.

INTERNATIONAL ACTIVITIES

Many international organizations engage in activities related in some way to marine pollution. Most of these activities are designed to exchange ideas and/or to coordinate national efforts. It is important to recognize, however, that in most cases, their concern with ocean pollution and particularly with ocean dumping is only incidental or peripheral. Although efforts such as the International Decade of Ocean Exploration will provide useful data, the IDOE does not give the highest priority to ocean pollution. Combined annual expenditures on activities designed to improve environmental quality, of which ocean waste disposal problems con-

stitute but a small part, probably do not exceed \$5 million, a small sum compared with the \$100 million of the FWQA in fiscal year 1970 for water pollution control and research alone.

Research concerned with ocean pollution and establishment of controls on waste disposal is undertaken mainly through national efforts, rather than by the intergovernmental agencies. Even national efforts are limited. Basic studies of the character of the oceans and the seabeds have dominated U.S. oceanographic research. There has been little or no emphasis on such questions as the capacity of the oceans to absorb wastes.

Several countries have begun to search for solutions. Canada is developing regulations governing the disposal of garbage and sewage from vessels. As now drafted, the regulations would apply to non-pleasure craft within the territorial sea and inland waters of Canada and would require new vessels in Canadian inland waters to carry sewage treatment equipment. The regulation would also prohibit discharge of garbage in all Canadian waters. Israeli scientists have been studying pollution of the Mediterranean coast off Tel Aviv since 1963. All new vessels constructed for the Argentine Merchant Marine are required to meet international standards on waste disposal, including holding tanks and oil-water separation tanks. Argentinian law also requires all foreign ships to be similarly equipped or access to Argentina ports will be denied. Similar legislation is contemplated for pleasure craft.

NEED FOR INTERNATIONAL ACTION

International cooperation is essential to preservation of the oceans. The quantities of wastes dumped in the oceans are increasing

rapidly in this country and will increase internationally as other countries experience similar waste disposal pressures. Consequently, control of ocean dumping necessitates action.

Recognition of the need for international cooperation is an initial step toward reaching worldwide agreements to control ocean pollution. There will be obstacles. Nations' interests in the oceans vary, as do their ideas on the controls that may be required.

RECOMMENDATIONS

The United States should assist in finding a solution to the international problem of ocean dumping through a twofold approach. First, it must systematically attack its own problems. As a significant polluter of the ocean and at the same time a technologically advanced nation, the United States must show its serious intention to meet its responsibility as a matter of urgent national priority. In demonstrating determination to preserve the marine environment, the Nation will develop valuable information on costs, effects, and technology associated with ocean dumping and its alternatives.

Second, the U.S. should take the initiative to achieve international cooperation on ocean

dumping. The Council on Environmental Quality recommends that at the outset the Federal Government develop proposals to control ocean dumping for consideration at international forums such as the 1972 U.N. Conference on the Human Environment at Stockholm. U.S. initiative should suggest a basis for international control over ocean dumping similar to the policy recommended in this report. Provision should be made for:

- Cooperative research on the marine environment and on the impacts of ocean dumping of materials;
- Development of a worldwide monitoring capability to provide continuing information on the state of the world's marine environment;
- Development of technological and economic data on alternatives to ocean disposal.

Domestic and international action is necessary if ocean dumping is to be controlled. The United States must show its concern by strong domestic action through implementation of recommended policy. But unilateral action alone will not solve a global problem. International controls, supported by global monitoring and coordinated research, will be necessary to deal effectively and comprehensively with pollution caused by ocean dumping.

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The President's Message on Waste Disposal

To the Congress of the United States:

The first of the Great Lakes to be discovered by the seventeenth century French explorers was Lake Huron. So amazed were these brave men by the extent and beauty of that lake, they named it "The Sweet Sea".

Today there are enormous sections of the Great Lakes (including almost all of Lake Erie) that make such a title ironic. The by-products of modern technology and large population increases have polluted the lakes to a degree inconceivable to the world of the seventeenth century explorers.

In order to contribute to the restoration of these magnificent waters, this Administration will transmit legislation to the Congress which would stop the dumping of polluted dredged spoil into the Great Lakes. This bill would:

- Discontinue disposal of polluted dredged materials into the Great Lakes by the Corps of Engineers and private interests as soon as land disposal sites are available.

- Require the disposal of polluted dredged spoil in containment areas located at sites established by the Corps of Engineers and approved by the Secretary of the Interior.

- Require States and other non-Federal interests to provide one-half the cost of constructing containment areas and also provide needed lands and other rights.

- Require the Secretary of the Army, after one year, to suspend dredging if local interests were not making reasonable progress in attaining disposal sites.

I am directing the Secretary of the Army to make periodic reports of progress under this program to the Chairman of the Council on Environmental Quality.

This bill represents a major step forward in cleaning up the Great Lakes. On the other hand, it underlines the need to begin the task of dealing with the broader problem of dumping in the oceans.

About 48 million tons of dredging, sludge and other materials are annually dumped off the coastlands of the United States. In the New York area alone, the amount of annual dumping would cover all of Manhattan Island to a depth of one foot in two years. Disposal problems of municipalities are becoming worse with increased population, higher per capita wastes, and limited disposal sites.

We are only beginning to find out the ecological effects of ocean dumping and current disposal technology is not adequate to handle wastes of the volume now being produced. Comprehensive new approaches are necessary if we are to manage this problem expeditiously and wisely.

I have therefore directed the Chairman of the Council on Environmental Quality to work with the Departments of the Interior, the Army, other Federal agencies, and State and local governments on a comprehensive study of ocean dumping to be submitted to me by September 1, 1970. That study will recommend further research needs and appropriate legislation and administrative actions.

Specifically, it will study the following areas:

- Effects of ocean dumping on the environment, including rates of spread and decomposition of the waste materials, effects on animal and plant life, and long-term ecological impacts.

- Adequacy of all existing legislative authorities to control ocean dumping, with recommendations for changes where needed.

- Amounts and areas of dumping of toxic wastes and their effects on the marine environment.

- Availability of suitable sites for disposal on land.

- Alternative methods of disposal such as incineration and re-use.

- Ideas such as creation of artificial islands, incineration at sea, transporting material to fill in strip mines or to create artificial mountains, and baling wastes for possible safe disposal in the oceans.

- The institutional problems in controlling ocean dumping.

Once this study is completed, we will be able to take action on the problem of ocean dumping.

The legislation being transmitted today would control dumping in the Great Lakes. We must now direct our attention to ocean dumping or we may court the same ecological damages that we have inflicted on our lands and inland waters.

RICHARD NIXON

The White House,
April 15, 1970

APPENDIX B***Task Force Membership*****Council on Environmental Quality**

Atomic Energy Commission
 Division of Waste and Scrap Management
 Department of the Army
 Office of Chief of Engineers
 Department of Commerce
 Environmental Science Services Administration
 Coast and Geodetic Survey
 Department of Defense
 Office of the Assistant Secretary for
 Health and Environment
 Department of Health, Education, and Welfare
 Public Health Service
 Environmental Control Administration
 Bureau of Solid Waste Management
 Department of the Interior
 Bureau of Commercial Fisheries
 Department of the Interior
 Federal Water Quality Administration

Department of State
 Bureau of International Scientific
 and Technological Affairs
 Office of Environmental Affairs
 Department of Transportation
 U.S. Coast Guard
 Executive Office of the President
 Office of Management and Budget
 Executive Office of the President
 Office of Science and Technology
 National Council on Marine Resources
 and Engineering Development
 National Science Foundation
 Office of the Director
 Smithsonian Institution
 Oceanography and Limnology Program

Senator MUSKIE. May I suggest second to my colleagues that we adopt the 10-minute rule on questioning so that we can get through the questioning as rapidly as possible and get on to the other witnesses. I will start timing myself.

Mr. TRAIN. Mr. Chairman, as a thought, you can be sure that I would be happy to return to the subcommittee on any occasion that you would wish to pursue any of these matters with you further.

Senator MUSKIE. I understand that, and that leads to my suggestion to members of the committee that we limit our questioning of Mr. Train to the absolute essentials. We will have an opportunity to bring him before the committee in Washington to get into the details. There are many local witnesses here today who would find it more difficult to come to Washington. I think that if we limit our questions to Mr. Train and to those things that might be of special interest to residents of this area, then we can get on to the other witnesses.

On the last point which you made concerning the international initiative that must be taken, Mr. Train, as you know Senator Baker, a member of this subcommittee, is the chairman of the Advisory Committee to the Secretary of State in preparation of the 1972 Stockholm Human Environment Conference. He is very concerned about the degradation of the oceans and hopes that it will be a primary subject of the conference. I will make sure that your comments on the subject today are brought to his attention.

Getting to your testimony, I am going to ask just one question concerning criteria. We have talked here this morning, and several members of the panel here have talked about the question of jurisdiction to deal with the problem of penalties to be imposed or restricting dumping. But our real problem, as you know, and I think as you indicated in your testimony, is to establish the criteria. In referring to my own legislation you touched upon the point, and I think rightly so. Water quality standards are not going to be sufficient to deal with this problem of ocean dumping. Yet we must develop criteria. The instinct is to say we will allow no more dumping of any kind. Until we find alternative ways of dealing with some of the waste, that may be an unrealistic answer. But it is an objective that we ought to explore.

On the other hand, if we set up a permit system which in effect would put the Government in the position of permitting some kind of dumping that ought really to be prohibited. Until we come up with the right kind of controls, the Government may find itself in the position of licensing pollution.

Neither of these alternatives is very acceptable, so the question of criteria, especially what kind of criteria, I think is the heart of this legislation. I would like to include in the record at this point those provisions in S. 1238 that deal with the subject. You might want to turn to those portions, Mr. Train, in the discussion.

I also would like to include in the record some criteria developed by the staff for introduction. The criteria haven't been introduced yet because we are not fully pleased with what we produced. Nevertheless, there are some ideas here that the committee ought to consider. Without objection, I will include these in the record at this point.

I wonder, Mr. Train, if you would like to respond to that point in anyway to further refine what you have in mind in terms of criteria?

Mr. TRAIN. I am glad to, Mr. Chairman.

Certainly I would agree with you that the matter of criteria is of utmost importance to this whole regulatory effort. I think we recognize that—well, let me go back; the basis of our whole approach here is first of all to bring all dumping under regulation, and I think that the bill does that, perhaps as satisfactorily as is possible.

Second, the policy set forth in our report is to end all harmful dumping as rapidly as possible, recognizing that in some cases, particularly disposal of sewage sludge by cities such as New York, this can't be done overnight. But, the policy is definitely to phase these out.

The bill does require the Administrator to establish criteria and I would certainly suppose that these would be a matter of public record, open to public scrutiny, to public hearings and certainly to examination and oversight by the Congress. Those criteria, as I pointed out, refer not only to the ecological impact upon the marine environment of specific dumpings but also to the availability of alternative locations and methods of disposal, including land-based alternatives. We very definitely believe that this has to be part of the criteria used by the Administrator in granting or in conditioning permits.

Senator MUSKIE. May I ask just a couple of specific questions referring to the criteria which we develop in order to identify the question of feasibility of control of the undesirable effects. For instance, one type of suggested criteria developed was this: Eliminate the adverse effect of discharge on human health or welfare including, but not limited to plankton, fish, shellfish, wildlife, shoreline, and beaches. Is it conceivable that the initial criteria could completely eliminate that kind of risk to the environment?

Mr. TRAIN. I think when you say "completely eliminate" my answer would have to be that such would be the long-range objective but that it is probably impractical to immediately apply it. I think you said any risks—

Senator MUSKIE. Or any adverse effect.

Mr. TRAIN (continuing). Any adverse effect. That would suggest, for example, that any dumping of sewage sludge would have to be banned immediately under such criteria and, as I have indicated, I don't think any of us feel that is probably practical as a first step.

Senator MUSKIE. Let me touch a couple of others for which I think the answer would be the same. I think it is important to identify the limitations to the effective discharge on the preservation of marine ecosystems including:

One, transfer concentration and dispersal of such agents or their byproducts to biological, physical, and chemical pathways;

Two, changes in marine ecosystems diversity of stability;

Three, species and community population dynamics;

Four, future uses of marine resources for drinking water, recreation and scientific studies;

Five, changes in ecosystem productivity and nutrient pools.

Would you agree with me that these adverse effects ought to be eliminated but that the initial criteria probably would not be able to eliminate them to a degree that would be desirable?

Mr. TRAIN. First let me say that all of the specific itemized effects to which you have just referred, Mr. Chairman, would be included in the phrase "impact on ecological systems and economic potentialities of the marine environment," that is in the present bill.

I would agree that here again these would be taken into account, and be perhaps the most significant factor in the setting of criteria, but that initially, at least, all adverse impacts could not be avoided.

Senator MUSKIE. I emphasize this point, Mr. Train, because there is too often a tendency to think that the first steps taken are sufficient. If we set up this kind of permit system, I am sure that the first steps will not be sufficient. If we intend the first steps to be as big as we can make them, if we are to continue a sense of urgency about the necessity of taking the forewarned steps, a great deal of this dumping, and especially of sewage sludge, which seems less harmful because it is itself a product of an environmental clean up program, will have to be severely, if not completely, curtailed in some fashion. Unless we keep that goal clearly in mind, constantly in mind, and related to some form of time table, we are likely to be content with the first steps because the next ones will be so costly economically.

I emphasize the point for this reason. I have used my 10 minutes but I may come back.

Mr. TRAIN. Could I just make one brief comment?

Senator MUSKIE. Yes, sir.

Mr. TRAIN. I certainly agree wholeheartedly on the importance of having a sense of urgency in this whole process and agree that the corrective steps must not be allowed to simply drift on. There must be a very firm set of timetables set up by the Administrator in phasing out dumping, if that is what is required in a given case. I would believe that he would ban outright a number of existing practices at the outset.

I do believe with that statement that there is still a need to have flexibility, and permit flexibility in the administration of this legislation, and when I say flexibility I don't mean leniency but I mean the capacity on the part of the Administrator to weigh objectively all of the factors that are involved including this matter of alternative disposal sites.

Now, this turns, as you know, on making progress in other areas outside of ocean dumping including this very important area of recycling. Our Council has now embarked on what I believe will be a very major study and examination of the whole problem of recycling of waste materials with the hope that we will be able to come forth in a matter of months, hopefully before this year is out, with some substantial, specific, objective proposals as we were able to do in the field of ocean dumping. Although when you are dealing with recycling I hasten to say you are dealing with an infinitely more complex and much larger problem. So I do think that flexibility of administration is an important element to be kept in mind.

Senator MUSKIE. I am glad to see you emphasize the importance of developing the recycling techniques and options, and I must say that I am disappointed in one respect. Last year the Resources Recovery Act, which was sponsored by Senator Boggs and myself with the objective of stimulating the possibilities of recycling, authorized \$172 million for the next fiscal year in this field. The Administration has asked for only \$19.2 million.

I understand the budgetary constraints, but nonetheless I can't resist making the point this morning that we need a greater sense of urgency if we are really to build up the alternatives to continue dumping, especially if one of those alternatives is recycling and reuse

of such resources as sewage sludge. I make that in as unpartisan tone as I can, but I think that since Senator Boggs and I were partners in this effort and we share that sense of urgency we ought at least to surface that fact.

Senator Boggs?

Senator Boggs. Thank you, Mr. Chairman.

I recognize the point you just made. Members of the Congress and Appropriations Committee have an opportunity to hold hearings and review this, so that everyone's point of view is considered.

Mr. Chairman, I don't want to take the time for a lot of questions at this stage. But on the point that Chairman Muskie discussed, could you tell us who would have the burden of proving that a proposed dumping of wastes would cause no damage to the environment? Would the Government have that responsibility or would the applicant have it?

Mr. TRAIN. We could consider that the applicant would carry the burden of establishing those facts. The Government, obviously, is going to assume a great deal of responsibility for research in the marine ecosystems, as it should, in the setting of criteria against which permit applications can be measured, but as far as burden is concerned, I certainly would insist myself that the burden would remain with the applicant.

Senator Boggs. I am glad that you touched in your testimony on the international aspect of ocean dumping. While we want to do everything we can, we expect international cooperation and hope to encourage it. Are other nations moving forward, conducting research on ocean dumping?

Mr. TRAIN. I have to say that on the basis of my brief contacts to date that they are not moving as rapidly forward in this area as we are very definitely, or as fast as we think and hope that they would.

I recount one conversation with an official of one nation, which I prefer to remain nameless. I said: "What is your government doing or going to do to stop ocean dumping off its shores?" His answer was very short and succinct; he said: "Nothing." And I said: "Well, that is interesting." Then he expanded on that; he said: "in fact, we think the oceans are a good place to put wastes."

So, with that comment let me say I think there is a certain amount of education required throughout the world. Now, I don't think that attitude is typical at all, there is increasing interest in this problem. I think, for example, in the Mediterranean area, along the southern coast of France and the coast of Italy where beaches are becoming commonly polluted and the wastes are washing up, the citizenry are becoming increasingly aware and upset over the problem. And, as I mentioned, in Japan there is a very great interest in the matters of marine pollution along the shores because fishing, shellfish are such an important part of the Japanese economy and livelihood. Pollution of the base for those resources has given rise to a great deal of public attention in the press, on television, and Japan has tremendous interest in this problem. And while I am not familiar with the details of the legislation submitted by the Japanese Government in December to the special session of the Diet, it is my understanding that it represents a really forward step for that Government and we are hopeful that things will move forward. But as I say, I think we are in a leading position and probably will have to remain there.

Senator BOGGS. Thank you, Chairman Train. It is great that you are here today. The committee and the people of Delaware, are honored to have you with us; we thank you for your very fine presentation.

Mr. Chairman, I have several more questions; I would like to submit them and ask Mr. Train to answer them for the record.

Senator MUSKIE. Without objection.

Mr. TRAIN. I will be glad to respond.

Senator MUSKIE. Senator Beall?

Senator BEALL. Thank you, Mr. Chairman.

I would just like to thank you, Chairman Train, for being with us today and I would withhold any questions I might have for a later date.

Senator MUSKIE. Thank you very much.

Senator BUCKLEY?

Senator BUCKLEY. Mr. Chairman, I would like to ask just a couple questions.

Mr. Train, while ocean dumping of sewage sludge from barges has been mentioned in your testimony, there is also an interesting problem to weigh: for example, many Florida communities are building outfalls with discharges into the Gulf Stream, which, of course, lies downstream of Delaware. Do you consider it feasible to control barge dumping without comparable controls over outfalls?

Mr. TRAIN. No; I don't. I feel that all these sources of waste discharge into the ocean should be brought under adequate regulation. It has been our feeling, as represented by this legislation, that control over the outfalls should be dealt with separately from the permit system which we are establishing over actual ocean dumping. They could be brought together into the same legislation in some fashion but certainly the problems, while they differ, go to the same overall concern that we are dealing with.

Senator BUCKLEY. Will you be introducing specific proposals to this end?

Mr. TRAIN. No. We, I don't believe, have anything to offer in addition to that which has already been submitted. The President's legislative program, which this committee has already started hearings on, would extend water quality standards beyond the territorial waters to include the contiguous zone, and I think that that is probably, certainly with respect to outfalls that are within the 12-mile zone, an adequate basis for control. Just how you would deal with an outfall that might go beyond the contiguous zone, I am not positive. It may be in that case you would want to use a permit authority such as exists under this legislation.

Senator BUCKLEY. That does lead me to the next question I wanted to ask; as you know the recently adopted Geneva Convention extends national jurisdiction to the contiguous continental shelf or the limit of the shelf for purposes of mineral exploration and development; does the administration contemplate urging a similar extension of jurisdiction of enabling each nation to the marine biology?

Mr. TRAIN. No; I do not believe so. The administration has suggested, as you know, an international agreement to establish an international regime with respect to the deep sea bed, which would somewhat modify the existing Geneva Convention with respect to the

resources of the Continental Shelf. I think it is our general view in this country not to favor extensions of sovereignty from the shore any more than is necessary. In specific cases, for example, one of the conventions which is presently before the Congress, I believe one of the IMCO conventions, would extend jurisdiction of a coastal State to any tanker discharging on the high seas; the present convention does give coastal States jurisdiction out to 50 miles, as I understand it, and the pending convention would give the United States jurisdiction over any tanker collision, for example, that was posing a threat to our waters offshore even though beyond 50 miles. We support that.

Senator BUCKLEY. Thank you, Mr. Train.

Mr. Chairman. I have no further questions.

Senator MUSKIE. Senator Case?

Senator CASE. Mr. Chairman, I feel there is no need for any further questions.

Senator MUSKIE. Mr. Train, thank you very much. I know there are lines of inquiry opened up that we will pursue later in Washington. Thank you, sir.

Mr. TRAIN. Thank you, Mr. Chairman; thank you, Senator Boggs.

Senator BUCKLEY. Mr. Chairman, I would like permission to introduce into the record an interesting report called The Ecology and Oceanography of Sewer Outfalls.

Senator MUSKIE. Without objection, it is so ordered.

(The report follows:)

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The Ecology and Oceanography of Sewer Outfalls



BEST COPY AVAILABLE

The Ecology and Oceanography of Sewer Outfalls

INTRODUCTION

During the spring of 1969 a special graduate seminar was held at Scripps Institution of Oceanography. The objectives of the course were as follows:

1. To determine what standards are presently being used to define "pollution" in the coastal waters of California.
2. To determine how and by whom these standards were set.
3. To determine how many and what type of outfalls now exist and how many more are in the planning stage.
4. To determine what type of ecological, oceanographic and/or engineering investigations are required and by whom, to insure that the standards under number 1 (above) are met.
5. To examine a series of reports on the investigations to determine their appropriateness and adequacy for the stated purpose.
6. To write a two part report consisting of a critique of the above subjects and recommendations (if needed) for improved methods to increase our knowledge of coastal pollution problems.

Because the literature on this subject is very large a selection of specific reports and papers was made. These were chosen to be representative of the following subjects:

1. The organization and function of the "State" and local "Water Quality Control Board".
2. Background theory and technical terminology in the field of sewage treatment and outfall design and operation (Refs. #1, 2, and 3).

3. Baseline studies and surveys which were designed to provide information on the natural, "undisturbed" coastal zone prior to use as a disposal site (Refs. #4, 5).
4. A summary paper on a long term study of the effect of an ocean outfall on the ecology of a coastal area (Ref. #6).
5. An engineering study by a private corporation for a "sewage control" district (Ref. #7).
6. Several "interim" reports of ecological and oceanographic surveys. These were short term studies, some of which were parts of longer term programs and include raw data and other observations that eventually were "summarized" in final reports (Refs. #9 and 10).
7. An account (by sanitary engineers) of the "problems of setting standards and of surveillance for water quality control (Ref. #11).

The method used to study this literature was as follows:

Two graduate students were assigned the job of critically reviewing each publication and presenting the subject matter to the entire class. The instructors and the class also read the material. In class, one hour was spent in the presentation of subject matter and an additional hour was spent in a discussion period. We looked, in each report, particularly for a clear statement of purpose, a well planned program of research, and appropriate and rigorous analysis of the resultant data, a clear and understandable presentation of results, and some conclusions.

A CRITIQUE

Summary of points

The following is a list of our conclusions, particularly pertaining to points one (1) and five (5) listed under "Objectives of the Course."

1. Critical objectives (i. e. operational questions) of the research are either not stated or so vaguely presented as to make it difficult for the reader to understand the purpose of the reports.
2. The plans of research in many cases were either poorly organized or poorly executed, for the resultant data are frequently too spotty to gain an adequate representation of variability of the things being measured.
3. There is a conspicuous lack of statistically oriented sampling and analyses. In an area as variable as the coastal zone this is essential.
4. The results as presented are frequently uninterpretable. That is, in addition to vague questions being asked, the reader has no idea of how or whether they were answered.
5. There are apparently no "standards" against which the ecological effects of waste disposal may be judged.

DISCUSSION

State Water Quality Control Board

To some extent the generally poor quality of the reports and publications we reviewed is a product of the vagueness and lack of clarity in the statements of "policy" and "objectives" of the State Water Quality Control Boards themselves. The only clearly stated "standards" for coastal water quality are those for coliform bacteria count (less than 1000 per 100 ml), mean dissolved oxygen concentration ("... the concentration shall at all places be greater than 5.0 milligrams per liter, except when natural conditions cause lesser concentrations..."), hydrogen ion concentration (-pH) and radioactivity. While these factors are of significance for the evaluation of a possible public health menace, they are by no means adequate measures of general ecological conditions or appropriate to the assessment of the status of particular plant and animal populations which are of economic, recreational or aesthetic value to man. Other statements on water quality objectives are so imprecise as to make it difficult to design objective field or laboratory studies to determine whether or not the objectives are being met. For example, it is stated that "... the water temperature shall not be raised to that point where it will cause an undesirable ecological change or have a deleterious effect upon aquatic life." The terms "undesirable" and "deleterious" are not defined and appear to be purely subjective. A definition of what is to be considered "deleterious" is clearly essential if research and/or monitoring agencies are to design investigations aimed at providing baseline information which would allow the eventual determination of "ecological change." It could be argued that any deviation from average conditions is an undesirable ecological change. On the

other hand, the assertion has been made that since the biomass in the vicinity of waste discharges frequently remains constant there have been no significant ecological changes. This latter is clearly not so since the species' composition and diversity of the constituent organisms almost always show changes. How much the flora and fauna should be allowed to change and over what area, before we may consider the changes to be "undesirable" or having a "deleterious" effect is obviously an important question and should be asked in as precise (preferably quantitative) a form as possible.

Other water quality objectives are similarly obscure: "there shall be no settleable solids, other than of natural origin, that would adversely alter the composition of the bottom fauna and flora; interfere with fish propagation or deleteriously affect their habitat; adversely change the physical or chemical nature of the bottom; etc.;" "there shall be no suspended solids . . . in amounts which would interfere with marine life. . . ." Photosynthetic activity should not be "adversely affected." "The deviation from natural background levels (of salinity) shall not be great enough to be harmful to desirable biota." These and similar statements on toxicants are not objectively defined; they depend upon a personal interpretation of the meaning of the underlined words and phrases. As such they are not particularly helpful in guiding the researcher in the design of a program that attempts to provide baseline information against which the effects of waste discharge may be evaluated. For instance, given the natural spatial and temporal variability of marine populations and the factors of their habitat, what sort of a deviation from average conditions may be considered "harmful," "deleterious," "adverse," "undesirable," and interference? It is possible to interpret such vague terminology to mean that any biotic change, no matter how small in magnitude or extent, is intolerable; or to mean, that only major disappearances of commercially important species are unacceptable. It would appear to us, therefore, that more clearly stated water quality control objectives are an essential step in any contemplated improvement of coastal waste disposal management.

Baseline Studies and Surveys

The biological studies of the Trinidad Head-Eel River report (an oceanographic study between Trinidad Head and the Eel River, 1964) (Ref. #4) suffer from a lack of depth corresponding to an overly ambitious scope of study. The purpose of this study was to obtain quantitative biological data for an area unaffected at the time by waste discharge and these data were to serve as a basis for comparison should sewage disposal be attempted in that area at some later time. The biological program consisted of monitoring local offshore phytoplankton, zooplankton (chaetognaths in particular), nekton, benthic intertidal infauna, subtidal invertebrate benthos, demersal fishes, and the Dungeness crab. Data on the local commercial and sport fisheries, including the razor clam and the Dungeness crab industries, were presented. A three year study in such a difficult area (due to weather conditions) with limited funds obviously cannot cover all aspects of this program in depth. The area itself reflects the variability of the California Current and the local inshore conditions and is tremendously complex. Consequently, the neritic studies suffer from a serious drawback: many years of study would be required to determine natural variability in oceanic populations and a study involving occasional sampling over a few years is not adequate to describe average conditions or the natural range of conditions in such an area. The intertidal sandy beach study suffers from a non-random sampling program so that all quantitative statements must be viewed as questionable. The offshore benthic studies are superficial due to the use of only major taxonomic groups as descriptive categories (this is also true of the midwater invertebrate studies) and to the lack of discrimination between organic

and inorganic material in a consideration of biomass, used to quantify the groups. The data on offshore fish and crabs, derived from the program's own research, as well as data available from published reports on the razor clam, the crab, and the sports and commercial fishery, are much more extensive, representative and adequate. It is only here that a reasonable estimate of mean values and natural variability is possible such that an adequate fund of data is available for comparison with studies at some future time.

The methods used in this study (Ibid., pg. 45) to determine current direction are certainly unorthodox, would be difficult to reproduce and in any case indicate only surface direction. There were no current speed estimates reported. Thus, these observations are of questionable value for predicting the fate of "contaminated" waters or of turbulent mixing. Several important measures of chemical nutrients were so infrequently made as to be of doubtful value. For instance, during the summer 1958 to 1961 only nine nitrate measurements were made between 0 and 20 meters in the Trinidad area (table 16G) and only 43 phosphate measures. These are too few to give an adequate picture of the background levels and their "normal" variability.

The survey of the southern California area (An Oceanographic and Biological Survey of the Southern California Mainland Shelf) (Ref. #5) although much more elaborate than the above study, suffers from many of the same problems. The objectives of this program are stated clearly in the introduction:

1. Develop quantitative biological, chemical and physical descriptions of representative marine areas unaffected by waste discharge.
2. Determine quantitative biological chemical and physical changes

in the marine ecology as a result of waste discharges.

3. Develop quantitative evaluations of indices and parameters for the biological study of the effects of waste discharges.

However, it is difficult for the reader to discover anywhere in the subsequent text a statement as to how well these objectives were met. This is especially true of the third objective which specifically states that quantitative, biological indices are to be developed. These, obviously, would be of great use to monitoring studies and to practitioners of the art of waste management.

In reviewing this report, we paid particular attention to Chapters III ("Physical and Chemical Properties of the Water"), VI ("Benthic Macrofauna"), and Ic ("Equipment and Methods") as being the most pertinent to the problems of waste management. The ocean and its populations, especially nearshore, tend to be highly variable. The design of sampling procedures and the plan and frequency of sampling should take into account this expected variability. We therefore examined the "methods" section for some rationale for the particular physical-chemical sampling plan and for indications of the frequency of measurement. We could find neither. This is an important deficiency in this chapter of the report. Although seasonal maximums, minimums and means were reported for temperature, salinities and chemical properties for particular locales, these are not necessarily adequate representations of the variability. For example, a sanitary engineer, in designing an outfall, needs to know the minimum expected stability of the water column at the site. The validity of his design will depend on whether this calculation is based on two measurements during the winter season or two hundred measurements taken over a variety of winter conditions.

The major contribution of the section on benthic macrofauna is the systematic sampling, identification, and quantitation of a massive amount of data. Serious drawbacks exist in the lack of interpretation of this data, and in the shortness of time over which the samples were taken.

The methods described are adequate, and give good indications of distribution of biomass, principal species, and how both of these are related to bottom type. But the critical question is how all these data can be of use in determining the effects of ocean outfalls. For these interpretations to be valid, one must have an indication of natural time variations in a particular community structure. Studies to determine such variations were only undertaken in two, nine-station grids, sampled four times over the course of one year. There are no data available to assess normal year-to-year variability. The other sampling stations are useful in terms of a faunal survey, but can be used to determine sewage effects only in the sense that a species once there, subsequently disappeared; or that some species, not previously noticed, is subsequently present and such changes could certainly take place without an influence of sewage. This is especially true in the shallow water and intertidal surveys.

The grid samples are useful in determining which species would be most likely to be in relatively constant abundance. A decline or increase in the abundance of this type of organism after sewage discharge begins nearby could well indicate a definite effect on the environment. What would be needed, then is a long-range study, preferably over a number of years and similar in methods to this study's grid sample, in an area where a sewage outfall is planned.

Such a study would probably allow for a real, quantitative measure of sewage effects.

In the summary of this section (p. 212), it was stated that high diversity (a parameter not objectively defined) should indicate clean water, while low diversity would indicate changed, upset, or unbalanced conditions. This may be true, and constitutes a good starting point for the determination of existent sewage effects. However, nowhere in the section except in the summary was this approach used or mentioned. Its validity apparently depends on intuition.

The information given on conditions around existing outfalls is totally qualitative. It's disheartening to find so much data with so little interpretation. It is merely stated that a Chaetopterus association, Capitella capitata, and Nereis procera increase in low salinity areas, and macroscopic life is severely depleted in the immediate environs of the outfall lines. The only attempt at comparison dealt with the biomasses within two miles of the Orange Co. outfall and within five miles of the L. A. outfalls, compared with those farther away. No significant differences were found. No reasons were given why two and five miles were selected.

One of the most useful results of the study was that no valid "indicator organisms" could be found. Capitella and Chaetopterus were found in abundance near outfalls, but also in large concentrations in other areas. This suggests the need to abandon the search for indicator organisms and to concentrate on the admittedly more subtle changes in the existing community.

In the "Investigation on the Fate of Organic and Inorganic Wastes Discharged into the Marine Environment and their Effects on Biological Productivity"

(Ref. #6) the authors present data concerning dispersion of dye released near the Orange County Outfall. Fluorometric determinations of rhodamine-B concentrations were compared with semi-theoretical diffusion laws for dispersion of dye patches and for dispersion of continuous release of dye in the outfall plume. An attempt is made to use these data to determine the influence of wind speed and water column stability on rates of dispersion.

While the experimental procedure appears to be sound, the treatment of the data is inadequate to allow substantiation of the authors' conclusions concerning the influence of wind speed and stability. The data seem to be reasonably well fit by the semi-theoretical laws but any systematic influence of wind speed or stability is difficult to determine due to the lack of reproducibility under seemingly identical conditions. No attempt is made to separate the influences wind and stability or to account for the fact that these effects are themselves correlated.

The data is of use in determining dispersion rates at the location studied over a certain range of conditions but any attempt to extrapolate to other conditions or location would be foolhardy.

The aspect of this report concerning primary productivity and production in a marine waste field is extremely confusing. The stated purpose of this part of the study is "..... to assess this magnitude of biological and chemical turnover within a marine sewage field." However, it is difficult for the reader to obtain this information from the data presented because of the method of presentation. For example, in the graphs (figs. 52 to 60) presented, "productivity" (on deck, ambient light measures) is given in terms of per total chlorophyll

and/or mgC per day per mg. . "Per milligram" of what is not stated, but presumably it is per milligram of chlorophyll a. It is not stated whether productivity per total chlorophyll and productivity per day per mg. are synonymous. However, in either case the expressions are of no use in determining "biological turnover" since productivity should, we think, be measured in units of mgC (fixed/unit time/unit vol.). This cannot be derived from the data presented in this report. Productivity per unit chlorophyll might be a useful measure of the physiological state of the phytoplankton populations present in a sewage field. For instance, near the "boil", photosynthesis could be reduced due to toxic inhibitory substances or the reduction of light intensity due to turbidity. The low productivity per unit chlorophyll could be due to this. As the field disperses, diffusion and turbulence could dilute these inhibitory factors, or could increase light transmission, resulting in higher productivity per unit chlorophyll. However, a further "explanation" is possible. It is known that different species of phytoplankton tend to show different productivities per unit chlorophyll. Further, these differences may occur within the same species due to senescence. The species composition and/or the average age of the phytoplankton in the sewage field could have changed due to turbulent mixing. This report leaves such questions unresolved.

The use of ultraviolet absorption, as a means of tracking a sewage field, is discussed in the next section of the report. The methods used were presented well and the results of the study clearly understandable. Unfortunately, these results did not agree well with the dye diffusion experiments. This may be due to the very few attempts made to compare the two (i. e. all ns are very

small in table 15 pg. 92, of Correlation Coefficients). Although, there is some doubt about exactly where the "background samples" were collected, the last section of this report is well done, easily understood and has not been over-interpreted.

The series of short-term studies by Turner et al (Refs. 9 and 10) are very useful in a qualitative way. These reports give extensive species lists of the larger benthic organisms found on a series of transects in the vicinity of major outfalls. The chosen method of sampling was the examination, by divers, of circular areas of 270 ft.² or 135 ft.²; together with quantitative sampling within these of 0.25 m² quadrats. The first of these methods is highly dependent on the skill and experience of the observer. If he is an excellent "naturalist", the results will be both qualitatively and quantitatively useful; if he is not, then the results will be of limited qualitative use and of no quantitative use. Since the divers who participated in this project are known to some of us to be highly qualified, we, ourselves, can accept their results. However, any attempt to duplicate the study would require that those making the attempt, first spend an inordinate amount of time gaining skill and experience. Thus, these studies are not particularly helpful as background information. A further weakness is that, apparently, in neither the "arc" samples nor quadrats was any attempt made to replicate. Therefore, calculations of mean population densities based on the data from these samples will have an unknown amount of variance associated with them. Any follow-up studies aimed at detecting changes in population sizes will be seriously jeopardized.

Orlob's (ref. #8) study of digested sludge discharge on the ocean environment is a semi-theoretical treatment of the rate of input, sedimentation pattern and rate, and rate of consumption ("stabilization") by marine organisms. The rate of accumulation of sludge on the bottom is expressed by the equation:

$$\frac{d h}{d t} = C - K h, \text{ or } h = \frac{C}{K} (1 - e^{-K t})$$

where C is the rate of supply, h is the accumulation, t is time and K is the rate constant of decomposition. The author has very good data on the output of sludge from the outfall and reasonably good experimental data on sedimentation characteristics. However, he has little or no data on utilization by marine organisms. He assumes values for K of 0.005 and 0.05 and calculates the time required for a dynamic equilibrium to be established i. e. the point, in time, when the sludge field will stop growing. We know of no a priori reason why these values for K were selected. The chemical components of sludge are apparently not well known. While there is little doubt that some of these may be utilizable by marine organisms, some others are probably not. Further, it seems likely that there may even be some inhibitory fractions, perhaps chelated to the organic molecules. Thus the prediction made in the summary and conclusions that "the maximum depth of accumulated sludge, both inert and volatile, under future conditions is expected to be less than one-half of an inch" is highly suspect. Further, it is curious that in his recommendations he did not suggest further studies on the value of K, the rate constant of decomposition. Since this value is the one about which the least is known and the most important parameter in the equation, it would seem only reasonable that further studies of it be done.

The final paper reviewed by us was concerned with the problems of setting standards and of surveillance for water quality control (ref. #11). The

authors of this report quite properly stress some of the statistical problems involved in surveillance programs. They allude to the concentrations and to the variable nature of the chemical constituents and coliform bacteria content of sewage wastes. Further, they stress that there are two aspects of this variability, spatial temporal. They suggest some rather arbitrary sampling methodology in the case of bacterial count statistics.

This report is useful and also points out an aspect of the setting of "standards" and of monitoring that we found to be particularly poorly done. However, it does not go far enough, particularly concerning the problems involved in assessing biological, chemical and physical "background" levels; that is, the "normal" situation against which the magnitude of "pollution" is measured. The coastal ocean and its populations of living creatures are highly variable, especially within the 200 foot depth contour. Populations here are patchily, not randomly, distributed in both space and time. Upwelling, mixing and eddy diffusivity are highly variable in both dimensions and there are occasional, statistically rare events, that could have a very great effect on the distribution of a sewage field in the receiving waters. Population structures, diversities and temporal variations in biomass are not well known nor are the factors influencing these variables well understood. These facts make it difficult to set objective standards or to design surveillance programs that will be useful and appropriate. However, approaches to these problems can be made through long time series observations, properly designed spatial distribution of sampling points and statistical analysis of the resultant data. At the very least, the reported data should include not only mean values, but also: 1. the number of

observations, 2. the range of values and 3. some measure of the variability, for example the variance (s^2).

The fate of many potential toxins in marine sewage is unknown, and yet these substances usually remain unmonitored, nor is there any mention of the necessity for monitoring. There are two classes of materials which might endanger marine food chains. The first class of substances includes those with which marine organisms have had no previous experience and thus no time to develop tolerance - - man-made substances such as synthetic detergents and pesticides. The second group of substances consists of a number of materials which organisms have encountered during their evolution, but often at much lower concentrations than present in sewage - - for example, some oils and metals.

Many metals are known to be essential for normal functioning of enzymes (e. g. Cu, Zn, Fe) but these same metals are highly toxic at higher concentrations. Arsenic, lead, and mercury are a few of the metals known to be toxic to man and detailed descriptions of poisoning are available from many clinical observations (e. g. Goodman and Gilman, 1965). The acute toxicity of high concentrations of metals to fish and many other organisms is likewise well known (e. g. WPCF Research Committee, 1966). There are apparently no published reports listing the concentration of these potential toxins in sewage effluent discharged into the oceans. Unpublished data (consult Los Angeles County Sanitation Districts and Hyperion Treatment Plant, city of Los Angeles), however, suggest that a number of metal species are being discharged in concentrations hundreds or thousands of times above background levels.

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The lack of concern about metals and other potential poisons is apparently based on belief that the oceans provide infinite dilution for any substances introduced by man. Unfortunately, this assumption is not true. In areas near outfalls, concentrations of dangerous materials will be raised over background levels and may conceivably reach levels harmful to many organisms. A more serious danger arises, though, from the possibility of poisoning through the food chain. Most organisms possess the ability to concentrate substances (such as a metal or a pesticide) many times over background levels of their food or environment. Thus, for example, kelp has been found containing 30 ppm arsenic, a level 10,000 fold above seawater and a level toxic to some marine organisms (see the Report of the Committee on Water Quality Criteria, 1968). The organisms that feed on kelp may concentrate arsenic even above this level. Thus toxic levels of a substance may result from concentration through the food chain, even though background levels in the water itself are not toxic. The tragedy of mercury poisoning in Minamata Bay, Japan (Faro and Siedler, 1960), documented the possibility of metal poisoning through the food chain: over 80 persons died or were permanently disabled due to effluent discharged from a chemical plant. Continuous monitoring of these potential toxins will be necessary to guard the well-being of human and marine populations against such tragedies in the future.

RECOMMENDATIONS

1. All research proposals and/or contracts should be submitted to external, independent, objective referees.
2. More research and survey effort should be applied to problems of:
 - a. Developing ecological "indicators" of pollution.
 - b. Biochemical and physiological indices of pollution.
 - c. Measurement of the persistence of non-degradable fractions, particularly those of known toxicity.
 - d. Concentration factors in organisms.
 - e. The statistical design of monitoring programs.
 - f. Methods of data analysis, review and presentation.
3. Basic research needs to be done on:
 - a. Physiology of marine organisms.
 - b. Sampling of marine organisms.
 - c. Community ecology and food chain structure.
 - d. Dynamics of concentration factors through food chains.
 - e. Currents, turbulence, eddy diffusivity and mixing in the nearshore regions.
4. There should be more centralization of effort in the study of effects and regional, long term planning of coastal waste disposal.
5. A great deal of effort needs to be put into the development of clear, unambiguous statements as to the standards to be maintained (or

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objectives to be met) for coastal water quality. In the case of populations and communities of marine organisms this will be difficult. However, we believe that these statements not only can be clarified but that they must be. The advice of ecologists, marine biologists, fisheries biologists, oceanographers and statisticians should be requested in this matter. These, in consultation with engineers and the Water Quality Boards, should be able to devise some interim, but operational standards. These could, in time, be revised depending on the results of research and monitoring done under points 2 and 3 above.

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THE ECOLOGY AND OCEANOGRAPHY
OF SEWER OUTFALLS

A SEMINAR HELD AT SCRIPPS INSTITUTION
OF OCEANOGRAPHY, SPRING 1969

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COVER DESIGN - S. J. CONGLETION

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(Subsequent to the hearing the following materials were received from the Council on Environmental Quality:)

CRITIQUE ON CEQ REPORT ENTITLED "OCEAN DUMPING: A NATIONAL POLICY, OCTOBER 1970" PREPARED FOR THE USE OF THE SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, U.S. SENATE, BY THE WORKING GROUP ON OCEAN DISPOSAL, ENVIRONMENTAL ADVISORY PANEL

I. INTRODUCTION

While the CEQ report is a useful first effort, your panel has found many things to criticize, as the following discussion will make clear. It may be useful at the start to state our own working philosophy. It is conservative. That is, we wish doubts always to be resolved in the direction of safety, given the interconnections and concentration mechanisms of the world ocean system, about which we already know, and for which there still remain immense gaps in our factual knowledge and our understanding. There are many lakes and rivers, and their waters are renewed on a relatively short time scale, providing the absence of large disturbance. There is only one world ocean system, and it must last the life of the earth.

In a larger sense the ocean is only one major component of man's natural environment. While it may be administratively convenient to divide problems into physical space (air, rivers, ocean, etc.), or political region, these problems truly interconnect.

One additional general point is that it would be good to set a world example on policy of waste disposal in the environment that could be presented at the 1972 United Nations meeting at Stockholm to serve as guidelines for other nations.

II. CRITICISMS

In the CEQ report there is an emphasis throughout, usually implicit, sometimes explicit, on the areas important for commercial fisheries, oyster beds, etc. There is a consistent lack of concern for the world oceans. This comes out in the recommendations as well as in the text (a glaring example can be seen in the proposal on page 24, dumping farther out to sea).

The assumption that dumping further out to sea alleviates the problem of waste disposal is faulty. The ocean, despite its size, is an interconnected system. The connections are partially due to currents and mixing but for the types of pollutants that are of most concern to man the most important connections are biological. There is no part of the ocean, with the possible exception of totally oxygen-free basins, that does not have a considerable variety and number of organisms living in it and passing through it. This has been shown even for the bottom of the deep sea by the pictures taken by J. D. Isaacs' ¹ "monster camera" which show large numbers of active predators and scavengers attracted to baits and by the quantitative studies of Hessler and Sanders ² which have shown that there is an abundant and diverse fauna living on and in the upper few inches of the bottom sediment.

All organisms that have been studied have shown considerable capabilities for concentrating materials—heavy metals, chlorinated organic compounds, etc. Thus, a concentration in the water that is of no importance in itself can become dangerously high in an animal or plant living in that water. This effect is often multiplied as one goes up the food chain towards top predators. These are not only the most active species, and thus generally wide ranging, but also the ones that man hunts. Many of the economically more important ones live primarily in the surface waters or in shallow water but they are connected to the deep water forms by the phenomenon of vertical migration which is practiced by large numbers of species at nearly all depths. Thus it is ridiculous to believe that once a pollutant is out of sight in the deep sea, it will be out of the interconnected biological systems that affect man.

Besides the scientific principle explained above, there is a political principle also, that it is illegitimate for the United States to trespass on the waters belonging to all mankind in the absence of a world agreement covering these matters. Until that comes about all ocean disposal by the U.S. should be within the territorial waters

¹ J. D. Isaacs, Scripps Institute of Oceanography, La Jolla, California Personal Comments.

² Hessler and Sanders, 1969, "Ecology of Deep-Sea Benthos", Science 163, 1419-1424.

of the U.S. This is a minimum interim measure. We are not here ignoring the interconnections described above. The question is a moral and political one.

Another essential fact is the dearth of knowledge about the deep oceans. It is a major error to add a dangerous quantity to a natural system that is not understood.

The CEQ report includes nothing about controlling ocean dumping by U.S. agencies abroad. This includes U.S. industries and the armed forces. Regulations that apply to U.S. based industries should also apply to the foreign branches of these industries. Ocean disposal controls should also apply to the military, both domestically and overseas. This includes the military in Vietnam with its haphazard spraying of herbicides, lead (bullets), and other persistent chemicals.

The recently passed legislation on oil pollution included an interesting concept. If oil is dumped in international waters by a U.S. vessel but ends up on territorial waters or coastline, then that vessel is liable for damages. Perhaps this precedent can be applied to the disposal of wastes in the ocean.

A serious gap in the CEQ treatment on inputs of artificial material into the oceans is that it makes no attempt to include continental effluents (rivers, rain run-off). It is widely recognized that U.S. rivers act as primary carriers for wastes transported to eventual dumps in the sea. The U.S. should attempt to control the transport of these water-borne wastes from its ports and territorial waters. For this we need guidelines for allowable concentrations of substances in river-borne marine effluents. This is the largest single class of ocean dumping, yet is largely ignored in the CEQ report. Existing legislation does not address itself to this problem and source directly. We emphasize that the CEQ report is incomplete without at least a call for this legislation.

The recommendations are full of such phrases as "phasing out," "stopped as soon as possible," and "interim programs." Even if the research needed to find solutions is funded, the whole history of government regulation shows that these phrases are full of possibilities for endless delays. A more specific approach, now being attempted in the case of auto exhaust controls, is worth considering. This is to set legislative deadlines, perhaps five or six years ahead, beyond which the undesirable practice will not be permitted. This makes the incentives for industry in the direction of the solution of the problem rather than in the direction, proven so successful in the past, of lobbying for delay.

It is our feeling that the following materials should cease to be disposed of in the ocean immediately (2 years):

1. toxic metals*
2. polychlorinated biphenyls
3. chlorinated hydrocarbons (general class of which 2 is special)
4. large amounts of organic solids and liquids that would cause a drastic alteration in the chemical and physical properties of receiving area
5. high level radioactive wastes
6. chemical-biological warfare agents
7. other toxic substances*

The following should not be dumped within five years: 1. Polluted dredge spoils that when dumped in receiving waters would cause a major change in properties of the area

It is of paramount importance that any accounting of the research needed to investigate a given problem be concise, accurate, and display intelligence and judgment about the system(s) it is working with. The CEQ report has failed this test in the area of research needed to study and define the present and future.

With any regulatory effort there should be a consideration of the question "who will watch the watchman?" Under our present system, outside of a few volunteers like Ralph Nader, the only recourse is Congress. The Joint Committee on Atomic Energy provides an interesting case history. While their supervision of the AEC has not always been constructive, and in the McCarthy era was very much the reverse, it has been very useful in the long run. Perhaps some similar procedure could be devised in the environmental area. Also, provision should be made in any legislation on ocean disposal for "citizen suits" that gives any citizen of the U.S. the power to bring suit against polluters or against the EPA if the Agency is not regulating ocean waste disposal as prescribed by law.

III. ALTERNATIVE SECTION ON "RESEARCH NEEDS"

Since the greatest criticism of the existing section on "Research Needs" is its generality and incompleteness, this revised section is a sketch for a more complete document:

*Administrator shall consider toxicity of substance and degradation products and possibility of biological concentration.

A. It is evident that a major research effort is required to improve our knowledge about the effect of wastes on the marine environment. For any large research problem as this, it is necessary not only to fund investigation on single discipline studies (such as the effects on marine populations due to dumping man's waste materials into the ocean) but also to fund multidisciplined studies that try to understand the ocean from a broad perspective. We must remember that in order to study the alteration of something, we need to know its original state. To use the terminology of ecosystem biologists, we need to understand the natural fluctuations of the complex parameters of our ocean environment (such as natural influx rates of nutrients, population densities, temperature changes, rates of removal, etc.) as an essential part of our knowledge of causes and effects in the area of human intervention.

To do this it is not enough to study the effects of ocean-dumped materials on a specific bay or estuary or ocean. At the same time we must have "pure" research in the field and laboratory on such things as natural fluctuations of surface- and sea floor-dwelling populations, natural fluctuations of temperature in marine environment, concentration factors and mechanisms of transport in marine and terrestrial food chains, sediment transport in marine environment, sea-air interface, etc. All fields of oceanography must be included (biological, physical, chemical) in single and multi-disciplined investigations due to the complexity of the system. Many of these questions have both short-term and long-term aspects; both must be considered.

B. Concurrently with this program, research must be conducted on the effects of human intervention. This should include all of, but not only, the following:

1. Quantification of amounts and routes of wastes going into the ocean with detailed chemical, biological and physical descriptions.

2. Study of the "stable" waste reservoirs. In other words, where are the long-term sites for the "dumped" material?

3. Investigation of the effects of the dumped material on the long-term reservoirs of the ocean. To do this, some type of monitoring program should be set up to do detailed and extensive investigations of several parameters in given areas. This monitoring program should also be implemented in other areas for reasons given in (A) and also in order to practice a little preventive surveillance of easily disturbed parts of the ocean. The program should be managed by EPA, but critically and frequently reviewed by outside experts.

4. The interaction of dumping with other man-made changes in the ocean, particularly its exploitation for food (fisheries, oyster beds, etc.), offshore oil production and marine transport of oil, and developing utilization of marine mineral resources.

C. The lead agency in this area will be the Environmental Protection Agency. The Agency will be expected to carry out research in its own laboratories, but to place strong emphasis on the support of research efforts in universities and other institutions, whose human resources are far larger and more diverse than those available in-house. This includes the funding of research by scientists in other countries, where this is the best way to get the job done. Certain special areas, as noted below, may best be dealt with by other agencies.

1. The overall level of funding for research, excluding engineering development, demonstration plants, etc., should be programmed to reach about \$50 million annually within a few years. Perhaps 40% of this should be spent within the agency, the rest outside.

2. In the case of universities, the mutual influence of research, graduate training, and other teaching must be provided for. There should be a modest fellowship program. Interdisciplinary efforts involving collaboration across departmental lines should be encouraged, but not the proliferation of new "institutes" for fund-raising purposes. Small grants for individual research can be very effective, and it is possible that this portion of the program is best administered by NSF.

3. The research areas should include, in addition to those discussed in (1) and (2) above, engineering research on possible new or improved disposal practices, studies in law and social science on the effectiveness of various forms of legal and administrative control, and research on the international and supranational aspects of these problems.

4. In addition to an annual report of the director of EPA, including the areas of research and development, there should be close and continuing liaison between the agency and the appropriate committees of the Senate and House, to insure the most effective influence of new scientific knowledge on the legislative process, and the best guidance of the research effort in areas vital to public welfare. Legislative language similar to that in the atomic energy area may be appropriate here.

5. There should be annual or biannual forums to bring together small numbers of working scientists and politicians to foster the interchange of ideas, data and problems. Recommendations and legislation could be proposed and debated in these "workshops". This would also provide a direct mechanism for maintaining "relevancy" in the research. I think this should also be tied to frequent (2-3 times per year) site visits by the administrators and politicians.

Final comments

The purpose of the present document is to provide a working guide to the legislative staff and to committee members on the areas in which the CEQ report on Ocean Dumping appears to us deficient or in error. We have not attempted a unified treatment on the scale of the report itself, though we hope that an improved version of the original report can be prepared before long. We hope that these pages can be useful in the process of legislation in this essential area.

Individual View:

METCALF & EDDY,
Palo Alto, Calif., April 30, 1971.

Dr. JAMES R. ARNOLD,
Department of Chemistry, Revelle College,
University of California, San Diego,
La Jolla, Calif.

DEAR JIM: I was hoping to see you in Washington this week at the NAS Meeting. The opening session was quite unusual because there were three members of the National Academy of Engineering addressing a scientific group on the problem of energy in the future. This involves our problem with the Senate Committee on Public Works.

To comment on your letter of April 19, I must first say that the critique is excellent. It hits the right spots just hard enough to make the Senate staff sit up and take notice.

My comments are as follows:

1. I like your concept of the "only one world ocean system" as opposed to the renewability of many lakes and rivers. However, the ocean itself is very renewable as evidenced by the activities at the sewage outfalls in Santa Monica Bay and off San Diego. I am not sure that you can draw a hard line as you seem to have indicated here. I agree with you that we cannot do irreparable damage to the oceans; neither can we do the same to the rivers or lakes. The important thing is the interconnection of all of the systems and you have brought this out.

2. On the bottom of page 2, I question whether all ocean disposal by the U.S. should be within the territorial waters of this country. If you can define territorial waters the way Ecuador and Peru do it, this is fine, but if you insist on a 3-mile or a 12-mile limit, we may be in trouble. I believe that all countries have certain rights to the great depths of the ocean and that certain decisions have to be made by the United Nations or similar group.

3. On page 3 you mention that United States-based industries should be bound by our regulations even though they practice in foreign areas. I think that there would be quite a legal problem in the interpretation of this so I would not get involved with this. The statement about Vietnam is rather weak and really does not add much to our report.

4. At the bottom of page 3 you get into the question of the pollution-carrying capacities of rivers which discharge into oceans. I am not sure that the existing legislation does not address itself to this problem and thus I would tone down this latter part of the last paragraph and probably try to mesh it with other legislation.

5. On the middle of page 4, why do you specify "organic mercurials"? I think that the microorganisms present in the ocean, particularly the benthic organisms are capable of converting inorganic mercury compounds to methyl mercury. The very next item, "high organic solids and liquids" is too ambiguous because it does not really specify what you mean. If you were to carry this to an obvious conclusion, it would mean that the City of Los Angeles could not discharge its sludge 7 miles out to sea because I would call that rather a high organic solid level. Also, "polluted dredge spoils" is very vague. The Corps of Engineers must be able to discharge the dredgings of the various rivers, such as the Hudson River, into the ocean. These are materials which ordinarily would be going to the ocean, but in the course of slowing down the velocities of the rivers, the suspended particles have settled in the navigable water channels and must be removed. Therefore, I think that this item is not well chosen. Similarly, the following item, "all nontoxic solid wastes" is too general. It means that we can dump nothing

into the ocean, even concrete from the demolition of buildings in the event that they want to build breakwaters or other types of water control facilities. It is too general a statement and must be qualified or removed.

6. I agree with you most heartily on all of your statements under item A on page 5. It is just so appallingly evident that we need more important fundamental work, particularly after having listened to some of the people at Scripps. The figure of \$50 million is probably okay, although it should really go higher than this because oceanographic research is so expensive. We really want to look at the depths between 10,000 and 15,000 feet.

7. I question whether we want to give Ralph Nader any credit. So much of his stuff is really belligerent rather than constructive. This is raising a red herring in the Congress and there is no need for doing that.

The rest of the report is excellent. My only question is whether the EPA is the only agency which should be involved inasmuch as there is so much oceanographic work to be done.

Sincerely yours,

ROLF ELIASSEN,
Senior Vice President.

EXECUTIVE OFFICE OF THE PRESIDENT,
COUNCIL ON ENVIRONMENTAL QUALITY,
Washington, D.C., June 22, 1971.

HON. JENNINGS RANDOLPH,
U.S. Senate, Washington, D.C.

DEAR SENATOR RANDOLPH: I have read the critique of our Council's report on "Ocean Dumping: A National Policy" prepared for your Committee by several scientists from the Scripps Institution and other institutions. Because of gross factual errors and the unusual logic in much of the panel's critique, I feel it necessary to set the facts straight and to make other comments.

Before doing so, I believe it would be desirable to explain briefly how the Ocean Dumping report was put together. The Council established an interagency task force with members from 15 Federal agencies. We carefully researched the literature on both ocean dumping and effects of pollutants on the marine environment, using 72 different sources of information (as indicated in the report). As we proceeded on the report, we not only checked its accuracy and soundness with Federal sources, but consulted with a number of nonprofit oceanographic institutions and universities, and worked closely with the National Academy of Sciences Committee on Oceanography and the National Academy of Engineering Committee on Ocean Engineering. I might add that we have received a number of favorable comments on the report from oceanographers and others interested in the marine environment.

The conclusions reached by the review panel are very similar to those reached in the Council's report. In fact, it appears that the panel is straining to find differences, which, for the most part, do not exist. We find it hard to believe, however, that the report was carefully read, if read at all, by the panel as the following examples will show.

1. In its introduction, the panel critique presents three underlying principles of its working philosophy: it is conservative wishing doubts to be resolved in the direction of safety; the oceans are interconnected, and are an integral part of man's total environment; and the United States should set a world example in waste disposal policy which could be presented at the 1972 U.N. Conference in Stockholm.

These principles are implicit and explicit throughout the Council report. The policy recommended in the Council's report would stop dumping of known or suspected harmful substances, and require proof that substances are harmless before dumping can be allowed—a most conservative approach to protecting the marine environment.

The Council report emphasizes the unity of the ocean ecosystem and the role of the oceans in the total environment. For example, the first paragraph of the entire report (p. iii, Foreword) states: "Oceans . . . are critical to maintaining the world's environment, contributing to the oxygen-carbon dioxide balance in the atmosphere, affecting global climate, and providing the base for the world's hydrologic system." And on page 34: "The oceans of the world are a truly international resource, forming a vast environmental system through which its components circulate or are dispersed by currents and the migrations of organisms."

Under *International Aspects of Ocean Disposal* (page 37) the Council recommends that the Nation "systematically attack its own problems . . . show its

serious intention to meet its responsibility as a matter of urgent national priority . . . demonstrating determination to preserve the marine environment . . .” and “develop proposals to control ocean dumping for consideration at international forums such as the 1972 U.N. Conference on the Human Environment at Stockholm. U.S. initiative should suggest a basis for international control over ocean dumping similar to the policy recommended in this report.”

2. The panel states that in the report “There is a consistent lack of concern for the world oceans.” There is absolutely no basis for this assertion. The emphasis throughout the report is on protection of the “marine environment.” The Council recognized that the biologically active nearshore areas are critically important to the health of the entire ocean ecosystem, and that since these areas are particularly vulnerable to human activities, they deserve special protection. (See page vi.)

3. The panel stated that the Council advocated dumping wastes farther out to sea rather than banning such dumping.

In the Council’s findings and recommendations, we stated the following principles: “Ocean dumping of material clearly identified to affect the marine environment should be stopped. “When existing information on the effects of ocean dumping are inconclusive . . . such dumping should be phased out.”

The complete misunderstanding by the panel must have occurred from a discussion of interim alternatives (see pp. 23 and 24 of the report) which suggested that during the phaseout period, it might be desirable to ship wastes farther out to sea to prevent serious deterioration in certain critical areas. But the major recommendation of the report was to either stop or phaseout *all* dumping of materials unless they were clearly inert and not harmful to the marine environment.

The incorrect assumption in the panel’s report that the Council advocated dumping wastes farther at sea as a long-term solution leads the panel to a discussion of the concentration and dispersion of pollutants and distribution of organisms in the ocean. That discussion implies that this was not discussed in the Council’s report. On the contrary, there is a much more detailed consideration of these matters in the Ocean Dumping report (starting on page 12) than in the panel’s critique.

5. The panel states that the CEQ report makes no attempt to include continental effluents (river rain runoff). It emphasizes that the CEQ report is incomplete without at least a call for legislation to control such discharges.

The foreword to the Ocean Dumping report clearly indicates that the majority of wastes comes from land-based sources. It also indicates that this report was confined by the mandate from the President to review the problem of ocean dumping, as opposed to land-based wastes.

During the period the Council was working on the Ocean Dumping report, however, it was also working with other agencies on two mechanisms to control land-based pollution. First, the Council worked with EPA, the Corps of Engineers, and the Justice Department to develop the Administration’s Refuse Act program requiring permits from all industrial discharges into U.S. waters. For the first time, this program would require dischargers to give Government data on their effluents and set forth a remedial program to meet water quality standards prior to their receiving a permit.

Second, at that time we were working with the Federal Water Pollution Control Administration (now the Water Programs Office of EPA) on the comprehensive water pollution control legislation which is currently before the Congress. That legislation would extend Federal jurisdiction to the contiguous zone, provide for specific effluent standards for all discharges, greatly strengthen enforcement authority, and provide Federal jurisdiction even when the pollution was occurring in only one State.

We are frankly mystified at the panel’s criticism that CEQ did not recommend actions covering land-based sources, since subsequent to the report, very comprehensive actions have either been implemented or submitted to the Congress covering such sources.

6. The panel sets forth a number of specific materials which should not be disposed of at sea. You will find that the Council’s recommendations on such materials agree with those made by the panel.

7. The panel made two recommendations with respect to legislation. It recommended that overseas dumping by the U.S. Government and U.S. firms also be regulated and that deadlines be established for terminating ocean dumping. In preparing the legislative proposals, both of these ideas were considered and rejected.

We foresee no feasible method of granting permits for ocean dumping that commences from outside the United States or does not occur in U.S. territorial

waters or the contiguous zone. Dumping by the U.S. Government from overseas operations would require an environmental statement under section 102 of the National Environmental Policy Act.

Deadlines might achieve the opposite effects as intended. We foresee rapid withdrawal of ocean dumping whenever alternatives exist, and certainly much more rapid withdrawal of dumping of toxic substances than the panel suggested. The deadlines could become a "least common denominator," allowing continued dumping for another five years, even when feasible alternatives exist.

8. The panel's criticisms of the research recommendations in the report are puzzling. I feel these recommendations clearly indicate the high priority the Council assigned to those areas mentioned by the panel; its criticisms appear more semantic than substantive and are highly inaccurate.

The critique said the Council "is only concerned with mission oriented research and not with the equally important fundamental work needed to understand this complex system that we are disturbing." Yet, one of the Council's major recommendations was: "Broad-based ecological research is needed to understand the pathways of waste materials in marine ecosystems. Such studies should be directed to a better understanding of the food chain from microscopic plants and animals to high predators; how pollutants concentrate in the food chain; the origin and ultimate fate of pollutants in the oceans; and the effects of concentration on the marine environment and eventually man."

The panel said, "it is obvious that a well coordinated and directed monitoring system is required. The CEQ makes no mention of this." Yet, one of the recommendations in the report is: "Effective national and international monitoring systems need to be developed . . . [t]here is also a need for data coordination so that data gathering and analysis efforts are not duplicated."

The panel said the CEQ report did not give adequate attention to research needs for alternate disposal techniques. Yet, one of the major recommendations of the report is: "Research is needed on the recycling of wastes and development of alternatives to ocean dumping." Chapter III of the report identified the major alternatives to ocean dumping, including those where most research, development, and demonstration would be necessary.

Perhaps the panel's only relevant point concerning the research recommendations was the lack of specificity. The Council attempted to set forth broad directions for research rather than to detail a research program. That responsibility is for the operating agencies and will certainly evolve from the requirements of the regulatory authority.

My major criticism of the panel's report is its excessive negativism. For years there have been studies, speeches, and testimony advocating protection of the marine environment and yet nothing had occurred. The Council's report provided a vehicle for strong legislation, which the President submitted to the Congress on February 8, 1971. That legislation is currently embodied in congressional drafts and will surely be enacted this session of Congress. This is a concrete accomplishment, which, considering their concern over ocean dumping, the panel's members should applaud.

It has, on the other hand, caviled about the report eight months after its issuance. Although we have been in touch with many institutions on both the report and the legislation, none of the panel members has contacted us.

Based on the superficial analysis the panel made of the report and the inexcusable factual errors, I can only conclude that its efforts have contributed neither to the development of sound public policy nor to high standards of scientific objectivity.

Not only is the Administration committed to cleaning up pollution of the seas through domestic action but it is aggressively pursuing international cooperation toward the same end. Only last week, the United States tabled a proposed Convention on ocean dumping at the London meeting of the Intergovernmental Working Group on Marine Pollution which is preparing the agenda for the 1972 U.N. Conference at Stockholm on problems of the human environment.

Sincerely,

RUSSELL E. TRAIN, *Chairman.*

Senator MUSKIE. Our next witness, Captain Francis D. Heyward, chief, environmental protection staff, U.S. Coast Guard. This gentleman would have some responsibility for policing and implementing the policy that we are talking about developing here this morning.

Captain, would you like to introduce your colleagues who are with you this morning?

STATEMENT OF CAPTAIN FRANCIS D. HEYWARD, CHIEF, ENVIRONMENTAL PROTECTION STAFF, U.S. COAST GUARD HEAD-QUARTERS

Captain HEYWARD. I will, Mr. Chairman.

I have asked Comdr. Richard M. Morse, immediately on my left, chief of the oceanography branch of our Marine Science Division, and Comdr. Daniel B. Charter, Jr., who is chief of the maritime pollution control branch of the Law Enforcement Division, to accompany me here in the event that the committee wants to ask them specific questions. I realize that your time is limited, however, and if you prefer we will be glad to respond in writing to any questions that the committee may have.

Senator MUSKIE. As in the case of Mr. Train, of course, we can pursue any lines of inquiry with the Coast Guard if we want to do so in Washington as well as here today.

Thank you, Captain.

Captain HEYWARD. Mr. Chairman and members of the subcommittee, I am Capt. Francis D. Heyward, chief of the marine environmental protection staff as well as chief of the Law Enforcement Division in the Office of Operations, U. S. Coast Guard.

It is a pleasure to appear before you today on behalf of the Commandant of the Coast Guard. I wish to assure the committee that the Commandant is personally concerned that the Coast Guard does everything reasonably possible to assist the subcommittee and to assist the other agencies of the Government in rendering its advice and participation in the solution of our entire environmental protection problem. He would have appeared today himself but unfortunately he had prior commitments and asked me to attend.

On his behalf, I wish to describe the present role of the Coast Guard in marine pollution control and ocean dumping, and to discuss the potential for expanding the role in ocean dumping regulation as a cost-effective means of dealing with the problem.

The Coast Guard has long been involved in matters affecting marine pollution control, providing the bulk of the Federal forces used in enforcing the Refuse Act and the various oil pollution acts. It was natural then for the Council on Environmental Quality to turn to the Coast Guard, acting on behalf of the Department of Transportation, for information and advice when it undertook to develop for the administration legislation to regulate indiscriminate ocean dumping. This cooperation between the Coast Guard and the Council was an extension of earlier liaison with the Council in preparation of the President's oil pollution message on May 20, 1970, and in the Council of Environmental Quality study on ocean dumping which was directed by the President in April 1970 and reported on October 7, 1970. (See p. 1965.)

The involvement of the Coast Guard in marine environmental protection, and in this instance, regulation of ocean dumping, is not only supportable from a logical standpoint but from a statutory one as well.

The Coast Guard has long been established as the Federal maritime law enforcement agency. Our officers and men are trained and experienced in matters of maritime law enforcement as they are trained and experienced in going to sea. The multimission capability of Coast Guard vessels, aircraft and shore stations, has provided a base for

accomplishing added marine related functions with minor increases in personnel and facilities.

The subcommittee is, of course, aware that the Coast Guard currently regulates the carriage of hazardous materials by the marine mode from the point of view of safety for the crew, the vessel and the port facilities. This function is intimately related to the control of loading and transporting of shore generated waste and thereby protecting the environment from indiscriminate dumping. Furthermore the Coast Guard's longstanding relationship with the maritime community in the regulation of shipping operations involves active and continuing channels of communication. Shipping owners and operators are accustomed to a degree of involvement by the Coast Guard in the conduct of their business.

Finally, the Coast Guard's extensive law enforcement authority and capability is coupled to statutory authority and capability for oceanographic research which gives its personnel insight into the scientific basis for pollution control. This multifaceted capability fits hand-in-glove with the requirements for administering an effective ocean dumping regulatory program, whether it be the enforcement of restrictions on ocean dumping, compliance with specific permits, or the surveillance, monitoring and analysis of ocean areas prior to and subsequent to a permitted dumping.

I might point out that, aware of the potential ecological dangers of ocean dumping, and consistent with the President's announced policy, the Coast Guard is already active in the area of ocean waste disposal as an adjunct to our marine environmental protection program. Even though we are lacking in the necessary statutory authority to take preventive action, we actively seek information on planned dumping and report all observed ocean dumping activities as to location, identity of materials and persons involved. This information is routinely furnished to other interested agencies and in specific instances has been reported to the Council on Environmental Quality and the Environmental Protection Agency. As an example, the recent proposal for disposal of the arsenic waste at sea, which was referred to by Congressman Sandman, was reported by the Coast Guard to the Council on Environmental Quality. We have also monitored several dumping operations upon request.

And again, I may say that in connection with the other case referred to by Congressman Sandman, we have been monitoring to see that the dumping activities of the waste barges that he was interested in took place at the prescribed locations. Incidentally, this was done at the request of Congressman Sandman's office.

We feel that regulation of ocean waste disposal requires three elements to be meaningfully effective:

(1) A central permit issuing authority; (2) an available surveillance and enforcement capability; and (3) effective monitoring activity.

Further, we feel strongly, based on our considerable past experience in the field of maritime law enforcement, that it is absolutely essential that a single agency have the responsibility for enforcement, and that that agency have some significant involvement at each stage of the regulatory scheme. It is only on this basis that an efficient and effective program can become a practical reality. The Coast Guard is ready to participate in the permit issuance process as well as the surveillance and monitoring stages. These roles are consistent with our resources and our present marine environmental protection

activities and, combined into one agency, can result in a very effective enforcement package.

The Coast Guard engages in a variety of mission areas which would support the role of the Environmental Protection Administration in regulating ocean dumping. For example, our experience and data collected in the regulation of hazardous material transport would be available to assist the agency in making the necessary determinations as to whether or not ocean disposal of a particular material should even be permitted.

The Coast Guard also collects oceanographic data in support of its other missions. This takes the form of daily observations from lightships and offshore light stations as well as from a variety of ships on ocean stations and underway on other activities. This oceanographic data, while presently limited in scope, can be useful in baseline determination. Although not yet directed to the pollution control program, the Coast Guard conducts coastal airborne radiation thermometer flights, on a regular schedule, utilizing aircraft equipped with sensors and disseminates periodic reports of sea surface temperatures. Seasonal oceanographic cruises are carried out in specially equipped vessels.

Additionally, our offices of research and development and engineering, which are developing monitoring technology and instrumentation to support our present operational programs, can apply their expertise in environmental areas and, indeed, are already doing so. Of particular importance will be the development of sensors specifically for pollution control purposes. Finally, our Coast Guard oceanographic unit and our marine scientists are skilled and experienced in evaluating environmental data as a result of our responsibilities in oceanographic survey work including the International Ice Patrol.

We have the capability and well deployed capital resource base with a substantial presence in the coastal and oceanic zone, which is essential to an effective regulatory effort. Our shore facilities dot the coastlines of the continental United States, Alaska, and Hawaii and are engaged around the clock in the performance of a wide variety of complementary functions.

Our vessel inventory includes a wide variety of ships with ocean dumping enforcement capabilities. These range from 65-foot tugs to 378-foot high endurance cutters. Our 161 rotary and fixed wing aircraft have a great surveillance and monitoring capability. In fiscal year 1970 a substantial number of flight hours were devoted directly to maritime pollution control. We hope to greatly increase the number of flight hours devoted to this surveillance program with the specific reactivation of six aircraft for pollution surveillance. Expansion of this program awaits the enactment by Congress of our fiscal 1972 appropriations.

The Coast Guard presently has a wealth of oceanographic talent available for increased monitoring responsibilities and the decision-making attendant upon permit issuance or refusal. Administrative and control staffs to support an ocean dumping regulatory program can readily be integrated into our district, marine inspection and captain of the port offices, which often embody the sole Federal Government presence in a particular area.

Having pointed out the Coast Guard's ability in the permit issuance area, I recognize that there are other factors that may lead to a decision to place this responsibility with some other agency. I should

like to emphasize, however, that the legislation should be broad enough so that the Coast Guard will have some involvement in the permit issuance regardless of the identity of the actual responsible agency. This would be essential for proper scheduling of enforcement activity and monitoring resources.

In order to carry out its various missions with optimal utilization of resources, the Coast Guard has imbued its personnel with a dedication to a multimission approach to planning and operations. We have repeatedly and successfully demonstrated that aircraft, vessels, shore facilities, and personnel can successfully and effectively perform several missions simultaneously. A vessel returning from a search and rescue mission may be easily diverted to exercise pollution control duties or to enforce the fisheries laws. An aircraft can conduct surveillance activities as an adjunct to almost any other mission. We are convinced that we can assimilate an added role in ocean dumping regulations in this concept.

It should be pointed out that while the Coast Guard now has most of the capital and staffing resources necessary to execute an effective ocean dumping regulation program, some augmentation would be required, particularly at the district levels, and the amount of augmentation would, of course, depend upon the limitation, or lack thereof, in the actual dumping permit.

In short, the Coast Guard has the contacts with the maritime industrial interests, the resources, the expertise and the desire to enforce an effective program of ocean waste disposal regulation. And the Coast Guard's long seafaring tradition should insure success in this additional task.

Thank you, Mr. Chairman.

Senator MUSKIE. Thank you very much, Captain.

I think, pursuant to my suggestion earlier, I will withhold any questioning at this point. Time is running rapidly, we have other witnesses, and we can get into further questions with the Coast Guard in Washington. I think that is Senator Boggs' evaluation as well.

May I express my appreciation to you. We will rely upon the Coast Guard and its facilities to discharge its role in this field, and we will pursue other questions later.

Thank you very much.

Captain HEYWARD. Thank you, Mr. Chairman.

Senator MUSKIE. Our next three witnesses are official State representatives of Maryland, Delaware, and New Jersey, in this field. I have glanced through each of their statements; they are long and very informative. I would like to invite all three to come to the witness table together and ask each of them to summarize his statement dealing with the effects, especially those peculiar to his State, and to concentrate on the proposal he would like to make.

I ask Mr. Austin Heller, Secretary of the Department of Natural Resources of the State of Delaware, representing Governor Peterson; Mr. James Coulter, Deputy Secretary, Department of Natural Resources, representing Governor Marvin Mandel, and Commissioner Richard J. Sullivan of the Department of Environmental Protection of the State of New Jersey, representing Governor Cahill, to come to the desk. I ask this abbreviation only in the interest of getting as rapidly as we can to the local witnesses who have their own points of view for us to hear.

Mr. Heller, do you have anyone with you whom you would like to introduce?

STATEMENT OF THE HON. AUSTIN N. HELLER, SECRETARY, DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL, STATE OF DELAWARE

Mr. HELLER. Mr. Chairman, yes, I do.

I have the pleasure to introduce on my right Lt. Gov. Eugene Bookhammer of the State of Delaware.

Senator MUSKIE. We welcome you, sir.

Mr. HELLER. On my left, Representative Derrickson and Senator Thomas Hickman of the General Assembly of the State of Delaware.

Senator MUSKIE. We welcome you gentlemen this morning.

All right, Mr. Heller, you may proceed.

Mr. HELLER. Mr. Chairman, members of the committee.

I am Austin N. Heller, Secretary of the Delaware Department of Natural Resources and Environmental Control. Today, I shall be representing the Honorable Russell W. Peterson, Governor of the State of Delaware.

We in Delaware are very pleased and privileged that you have selected the "State That Started A Nation" as one of your public hearing sites concerning the uncontrolled and undesirable dumping of wastes, municipal and industrial, into the very waters bordering our shores.

Delaware's most vital assets are its estuaries, beaches, fishing, both fin and shellfish, and its great recreational resources which serve literally millions of people from at least four States other than Delaware. Therefore, it is paramount that we examine critically any practice which can or may affect the quality of Delaware's vital natural resources.

Concern of our preservation of the natural resources is a factor in Governor Peterson's program to promote selective industrial development in the State of Delaware. He recognizes the need for and the importance of having an adequate number of jobs for our growing population through both expansion of existing enterprises and the attraction of additional ones. But he also recognizes the importance of the overall quality of our environment, not just the quality of our air, water, and land but also the quality of life. To entice industry to Delaware without proper regard for all of these factors could destroy the opportunity to build a higher quality life for all Delawareans.

The Governor's prime concern stems from the fact that strong economic forces point to the Delaware Bay as the most attractive place on the east coast for building a major transportation and industrial complex. The wrong decision now could trigger an industrial explosion that would line our bay and riverfronts with a complex of refineries, steel mills and allied industries. The Governor is well aware of the importance of refineries and steel mills but he is also aware of the importance of recreation areas. They clearly are incompatible uses for the same land. Delaware is fortunate in having a river and bay area which is ideal for both uses. But a choice must be made because we cannot have it both ways.

The Governor has said that the key issue is not whether refineries, for example, are good or bad, but whether they are the best use for the

land involved. The Governor has made clear his determination to lead the State into preserving the bulk of its bay and coastal areas for recreation and compatible commercial and industrial. We are convinced that this will result in a higher quality of life that will strongly encourage most industry and business to want to come to Delaware.

This same concern in the preservation of our natural resources prompted the Governor a year ago to form a task force on marine and coastal affairs headed by Dr. James H. Wakelin, Jr., internationally known oceanographer who just recently was appointed as Assistant Secretary to the U.S. Secretary of Commerce. The task force assignment was to prepare a master plan for the healthy preservation and sound development of our bay and coastal areas. Its preliminary report will be released on April 8 and will be of extreme value in guiding future decisions affecting our marine resources.

When man realized that his inadequate inland waste disposal practices could no longer continue without disastrous effects, he turned to the ocean. Little, if any, consideration was given to the potential effects but economics and convenience were the ruling factors. The oceans have been considered as a huge sink capable of accepting unlimited quantities of our waste material. The sooner we realize that the vastness of the ocean is not available for dilution, that ocean current fluctuations, temperature variances, and changing depths lead to stratification that prevents complete mixing, the sooner we can begin to recognize our error.

The recent comprehensive report on "Wastes Management Concepts for the Coastal Zone"¹ by the prestigious National Academies of Sciences and Engineering states * * * "The chemical composition of the ocean tends to be stabilized not only by its great diluting capacity, but also by the fact that the concentrations of most constituents are in a near steady state condition, being removed by various processes at about the same rate that they are being added. In spite of these stabilizing factors, it is possible for man to affect the ocean in significant ways. The effect of a changed rate of flow of a substance into the ocean as a result of man's activities cannot be judged by what would happen to the average oceanic composition; local efforts are more important than the average effect.

The ocean is well stratified, and mixing is slow. A surface layer a few hundred meters thick may accumulate manmade wastes that are diluted by deeper water only very slowly. This appears to have happened in the case of lead, which passes from automobile exhausts into the atmosphere and then passes in part into the ocean. The lead concentration into the upper layers of the oceans is now several times the average lead concentration in the total ocean.

Discharges near land, where the water is shallow, can have significant effects on the local ecology. The water overlying the continental shelves is only 8 percent of the total volume of the ocean, and circulation is often limited. In some areas, essentially separated from oceanic current patterns, nutrient elements and organic materials added by man can cause serious reductions of oxygen levels. Even a sea as large as the Baltic has been reported to be affected in this way * * *

We, in Delaware, have recognized the hazards of the dumping of untreated or partially treated waste into our bays, estuaries, and

¹ "Wastes Management Concepts for the Coastal Zone", National Academy of Sciences, National Academy of Engineering, Washington, D.C., 1970.

oceans. In 1964, our staff advised the city of Wilmington that secondary treatment was needed and required for the cleanup of the Delaware River. A full scale pilot plant was constructed which provided secondary treatment of 25 million gallons per day out of 70 million gallons per day of waste water. The remaining 45 million gallons per day was given primary treatment. Data generated by the pilot plant helped to design an addition which offered the unique feature of treating even salt water. The complete plant is expected to be on stream by 1973. We are proud that Wilmington is at least 4 years ahead of other large metropolitan areas in the Delaware Valley.

With the advent of secondary treatment, more sludge is produced. Wilmington also considered ocean dumping as one solution. In keeping with our commitment to enhance and preserve our coastal waters, the city of Wilmington decided to provide land based facilities for sludge handling. Delaware is also taking a leading part in recycling solid waste matter and the sludge from the plant is to be used for making a salable compost. This plant is being designed to accept all the solid wastes from the Wilmington-New Castle County area and recycle material such as glass, aluminum, paper, iron and steel products. The organic material will be combined with the sludge from the city of Wilmington and made into a soil enrichment product. This product can be used for golf courses, parklands, and even home gardens.

I am happy to report that we are making similar progress in the other two counties of Delaware. The levy court of Kent County is expected to sign contracts this week for the construction of county-wide regional sewer system. This system will collect waste water from industries and towns in Kent County and transport it to a central location where a very high degree of secondary treatment will be provided. This system will assure substantial improvement in the quality of our tidal streams in Kent County.

Current plans are to use the treated effluent from this system for irrigation purposes. In this manner, we cannot only conserve ground water, but can benefit from the nutrient value as well. In addition, we can greatly reduce, if not prevent, salt water intrusion through reduced pumping and recharge.

Similar regional systems are being planned in Sussex County also. In fact, one such system would serve the fair city of Rehoboth, where we are meeting today, and the neighboring areas of Dewey Beach and Lewes. Although Federal regulations would permit the discharge of primary treated waste into the ocean, we have taken the position that a high degree of secondary treatment would be definitely required prior to discharge into the ocean.

I would like to point out one common feature of all these treatment systems. In each case, the highest practicable degree of treatment has been required and particular attention has been paid to the disposal of sludge generated. Ocean dumping has been rejected as an alternate method.

We wish to bring to your attention some practices of disposal of municipal sludge and concentrated industrial waste in our near shore area.

May I ask the indulgence of the Chairman—we have a few slides overhead and will you be kind enough to just turn a moment.

The acid waste from the titanium dioxide plant of the DuPont Co. was traditionally discharged into the Delaware River under controlled conditions for many years.

Senator CASE. Where is that?

Mr. HELLER. Can you point that out for me?

Senator CASE. I didn't mean to interrupt, but you mean the main plant way up?

Mr. HELLER. Yes, my impressions.

Senator CASE. This is south of the bridge?

Mr. HELLER. Yes.

The company, realizing the effort toward clearing up the Delaware Estuary, voluntarily decided to segregate and concentrate the acid waste and dispose it in the ocean. After consulting with State pollution control agencies of Delaware, Maryland, New Jersey, Federal resources agencies and the Corps of Engineers, the company chose an area approximately 47 miles southeast of the mouth of the Delaware Bay. On an annual basis, the company is discharging 108 million gallons per year. The principal constituents are sulfuric acid and ferrous sulfate. The amount of ferrous iron discharged is about 11,000 tons per year. In addition, there are salts of other metals such as zinc, which are impurities in the titanium dioxide ore. This acid disposal practice has been going on for over 2 years. We understand that the DuPont Co. has retained the University of Delaware marine laboratories for performing continuing studies on the marine ecology of the area.

The city of Philadelphia has been barging digested sewage sludge for disposal at a location 11.4 miles southeast of Overfalls Shoals since 1961. The volume of sludge barged has increased from 28 million gallons per year in 1961 to almost 100 million gallons in 1970. This sludge is produced daily by the three mammoth sewage treatment plants of the city of Philadelphia; two of which provide primary treatment for 253 million gallons per day and the third, a low secondary treatment (75 percent BOD removal) for 165 million gallons per day. In addition, the city of Camden, town of Bridgeton, also barge their raw sludge to the same disposal area. This disposal area covers approximately 1,560 acres.

From information provided by the city of Philadelphia, we find that the solids content of this sludge averages about 10 percent.¹ Therefore, on a dry basis, approximately 50,000 cubic yards of sludge was dumped into the ocean in 1970. If this sludge is settled uniformly over the entire 1,660 acre disposal area, it will amount to two-tenths of an inch of waste material on the ocean bottom. We must remember that the surf clam we are concerned about lives on the bottom of the ocean. If the sludge is not settled properly and remains in suspension, it will reduce the amount of sunlight penetration and will affect the productivity of the area. If the currents are strong, the suspended sludge material could be swept several miles and probably toward the mouth of the Delaware Bay.

We also understand that approximately 60 percent of this sludge comes from the northeast sewage treatment plant, and the remaining 40 percent from the southwest sewage treatment plant.² It is quite obvious that these sewage treatment plants serve not only the human

¹ "Sludge Disposal by Barging to Sea," by Carmen F. Guarino, Water and Sewage Works, Reference No. 1907, pp. R126-127.

² Personal communication, Mr. Ralph Porges, chief, Water Quality Branch, Delaware River Basin Commission.

population of Philadelphia but also the many, many industries. Some of the industrial wastes tend to concentrate in the sludges and this is especially true of heavy metals. A recent analysis of the content of heavy metals in the digested sludge of Philadelphia is included as table I. This indicates substantial amounts of zinc, nickel, manganese and chromium in the waste being barged. We do not have any specific information on the quality of sludge being barged by the cities of Camden and Bridgeton. However, since this is raw sludge, it has extremely high amounts of organic material and bacteria in addition to heavy metals.

TABLE I.—AVERAGE LEVELS OF SOLUBLE TOXIC METALS IN DIGESTER AND LAGOON BOTTOM SLUDGE

(Parts per million)

Metal	Sludge to barge	Digester bottom sludge
Cadmium.....	0.02	0.60
Copper.....	.04	.23
Chromium.....	13.60	31.00
Lead.....	.04	.30
Manganese.....	50.00	57.00
Nickel.....	17.50	15.30
Zinc.....	22.50	58.00

Source: Data courtesy of the Philadelphia Water Department from a memorandum dated Mar. 10, 1971.

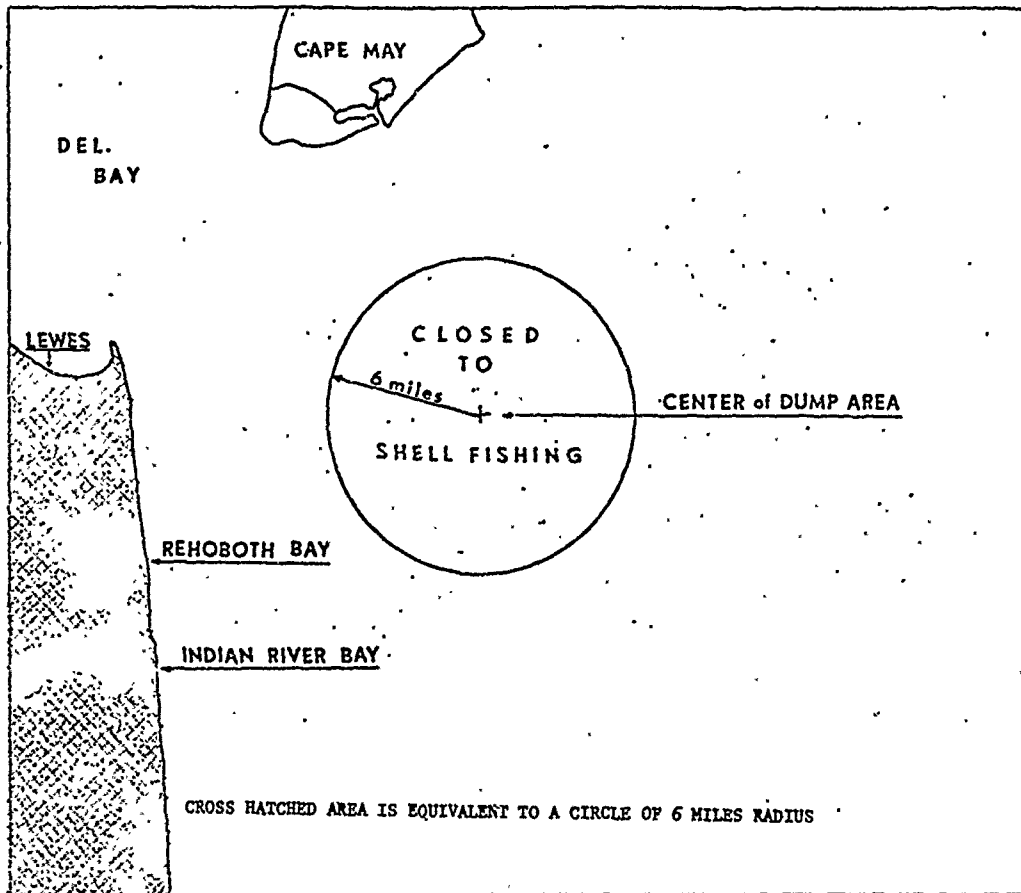
Senator MUSKIE. How far is the center of that dump area from the mouth of the Delaware Bay or Cape May? What is the distance from the center to Lewes on the one hand and Cape May on the other?

Mr. HELLER. About 12 miles, I believe, sir. The dump area is about 11.4, I am informed.

As a result of such practices and on the basis of field investigations,* the Department of Health, Education, and Welfare has closed 72,346 acres for the purpose of surf clam harvesting. It is our understanding that Mr. James L. Verber, oceanographer, for the Department of Health, Education, and Welfare will present the technical details leading to the closure later today. The impact of such closure is obvious and the clam industry in Delaware is hard pressed. A circle of 6 miles radius in the ocean, as shown in figure 1, may not be significant at first sight. An equivalent area when superimposed on land will show the impact; for example, it would be equivalent to a strip of land 6 miles wide extending from Lewes to North Ocean City and including all of Rehoboth Bay, Indian River Bay, and part of Assawoman Bay. This far surpasses the total area of clam beds subject to control by the State.

* "Preliminary Investigation of Sewage Sludge Dumping Off Delaware Bay" by Buelow, R. W., Pringle, B. H., and Verber, J. L., Bureau of Disease Prevention and Environmental Control, National Marine Sciences Laboratory, Narragansett, R.I., U.S. Department of Health, Education, and Welfare.

FIGURE 1



Senator MUSKIE. Let me be clear on the statistics you gave us earlier: How many gallons of acid waste are dumped by the DuPont Company in the center of this area?

Mr. HELLER. 108 million gallons, sir.

Senator MUSKIE. Is this the area where this is being dumped?

Mr. HELLER. The DuPont site is 40 some miles out, it is not the same area.

Senator MUSKIE. All right, what is being dumped in this area?

Mr. HELLER. The sludge from the city of Philadelphia, the towns of Bridgeton and Camden are being dumped into this specific area.

Senator CASE. The city of Camden.

Mr. HELLER. The city of Camden, excuse me.

Senator CASE. And Bridgeton is out now, according to Congressman Sandman and they have their own disposal plant on land, is that right.

Mr. SULLIVAN. That is correct.

Mr. HELLER. That is fine. We are very happy to learn of that change.

This would be equivalent to a strip 6 miles wide extending from Lewes to North Ocean City, and including all of Rehoboth Bay, Indian River Bay and part of Assawoman Bay. This far surpasses the total area of clam beds subject to control by the State. We feel this is a very significant point, Senator, it indicates the magnitude of the area. As one might look at this 6 miles out in the ocean site per se might not seem like a great deal but when you superimpose it as we have here and reflect its overall effects it becomes very significant, indeed.

Senator MUSKIE. How effectively can that be monitored. How effectively can that restriction be enforced in an area that size?

Mr. HELLER. I think the point was made by Mr. Train a few moments, that one really needs to deal with this at the point of departure not at the point of dumping.

Senator MUSKIE. I am talking about monitoring the shellfish, taking the shellfish in this area.

Mr. HELLER. This can be done, yes, sir.

Another factor to be considered is the long-term effects through concentration of heavy metals in the shellfish tissues. Table II shows some of the expected concentration factors. Since sea water contains many of these heavy metals in trace concentrations, nature has provided these organisms with the ability to selectively absorb nutrient elements. When we change the natural concentrations of heavy metals in the sea water by dumping waste materials, these organisms have no other choice but to use sea water. They are not able to stop concentration mechanisms when the required amounts of nutrients have been absorbed. As an example, a Quahaug clam can concentrate chromium by approximately 23,000 times. One can readily see that this phenomenal ability can easily eliminate any benefit that may have been expected due to dilution. The dilution factor in the dump area, assuming complete mixing over an average depth of 50 feet for the 1,660-acre dump area, would be 39,000. Since we cannot assume complete mixing, the concentration of pollutants can be expected to vary in the dumping area. This variation can be expected to be even more pronounced at the bottom of the ocean—the habitat of the clams. Herein, we can anticipate the presence of heavy metals will present a serious toxicity factor. It follows that ecological upsets from these practices will result. Recent sampling suggest that the ecological balance has been upset.

TABLE II.—TRACE METAL ENRICHMENT FACTORS FOR SHELLFISH¹ COMPARED WITH THAT OF THE MARINE ENVIRONMENT

Element (1)	Oyster (2)	Quahaug (3)	Soft shell clam (4)	Surf clam (5)	Mussel (6)	Whelk (7)
Cadmium.....	¹ 318,000 226,000	750	800		¹ 100,000 (2) 800	6,300
Chromium.....	¹ 60,000 31,600	23,400	10,400			
Copper.....	¹ 13,700 14,800	900	2,000	450	¹ 3,000 1,150	3,800
Iron.....	¹ 68,200 6,700	3,000	41,000	18,400	¹ 196,000 2,900	
Manganese.....	¹ 4,000 2,900	2,900	3,350	1,100	¹ 13,500 1,500	2,100
Nickel.....	¹ 4,000 (1) 3,250	4,500	4,250			
Lead.....	¹ 4,000 4,100	5,800	3,400			
Zinc.....	¹ 110,300 148,000	2,100	1,700	1,525	¹ 9,100 2,200	8,200

¹ "Trace metal accumulation by estuarine mollusks," by Pringle, B. H., et al. Proceedings of the American Society of Civil Engineers—Journal of the Sanitary Engineering Division, vol. 94, No. SA 3, June 1968.

Senator MUSKIE. Of course, what you are saying here is this: Even if you find a way to dilute the concentration of these metals in a particular area, these organisms have the natural capacity to absorb them and concentrate them in these quantities?

Mr. HELLER. Yes, sir; that is precisely correct.

Our conclusions can be best summed up by a statement in the National Academies' report¹ . . . "Optimum waste management can be attained only through adequate knowledge of the ecological effects of the wastes under a wide range of conditions. One cannot imagine a time when all will be known about the ecological effects of wastes, but it is important that more information be acquired than is known at present. Biological, chemical, and physical effects must be considered, and plans must be made for various programs of observation to monitor the effects of wastes that are discharged . . ."

In summation, may we suggest to the members of the subcommittee of the Senate Public Works Committee to take the following actions:

1. A national goal be set to eliminate dumping into the ocean of solid wastes, municipal and industrial sludges, concentrated industrial wastes, oil, hazardous substances and any other toxic wastes. However, effluents receiving a high degree of secondary treatment and disinfection should be allowed to be discharged into the ocean.

Senator MUSKIE. May I make a point that I think is accurate, and ask you whether you can confirm it.

I am told that shellfish along the coast contain cadmium in concentrations above public health levels established by the Federal public health agency.

Mr. HELLER. This may be the case, Senator. I believe there is to be a meeting shortly, convened by HEW to examine the status of the levels of heavy metals in shellfish.

Senator MUSKIE. Sewage sludge is a source of these metals?

Mr. HELLER. No question about it, sir.

An abatement program be established to control the dumping practice that now exists and further, that steps be taken to preclude the addition of any new sources. As an immediate part of the program, top priority be given to the elimination of highly toxic substances such as mercury, cadmium, arsenic, hard pesticides, and so forth.

In answer to your specific question, Senator, this is an analysis of some of the heavy metals that were found in the sludge, and this represents the sludge from the city of Philadelphia.

Senator MUSKIE. This is from the area which is on the earlier map?

Mr. HELLER. That is right, sir. This is the nature of the materials that are being dumped with respect to heavy metal characteristics.

For the specific area off the Delaware coast, we recommend that municipalities and industries presently using ocean dumping as a means of ultimate disposal be allowed to continue the practice at the present sites for a period not exceeding 6 months. During this period, the dischargers would have to conduct environmental impact studies in areas off the Continental Shelf so that an acceptable site for moving the location of discharge can be determined.

Senator MUSKIE. May I ask another question about this sewage sludge? The facts represented by this table indicate that there is a great deal of industrial waste in that sewage sludge.

¹ Op. cit., p. 54.

Mr. HELLER. That is a correct conclusion.

Senator MUSKIE. What are the recovery possibilities of these metals?

Mr. HELLER. It would be rather difficult for me to tell you precisely what the chances are of removing the metals. One should consider the incineration of the sludge and if one were to do so the metals would likely be in the ash.

During the period when ocean dumping will be permitted, it is recommended that the Federal Government use its surveillance capability to insure that the site approved is used and that the material to be discharged meet Federal specifications.

It is recognized that the ocean and its ecology is not the sole province of any one nation. Therefore, it is urgent that steps be taken to develop international ocean dumping agreements which would insure the proper use of man's greatest food source.

Thank you, Senator.

(Article referred to in Mr. Heller's testimony follows:)

SLUDGE DISPOSAL BY BARGING TO SEA*

By Carmen F. Guarino**

One of the considerations in the selection of the present sites for Philadelphia's water pollution control plants was the availability of adjacent low lands which could be used to lagoon the sludge residue from the treatment process.

NORTHEAST PLANT

From 1923 until 1954, the natural low lands in the vicinity of the Delaware River were adequate to dispose of the digested sludge from the Imhoff and, later, the modified aeration plants at the Northeast works. However, in 1954, it was apparent that the four lagoons, which covered sixty acres and having an average depth of eight feet, would soon be filled to overflowing. To extend the life of the lagoons, the natural dikes surrounding them were raised an average of two feet and, in 1957, an additional lagoon—seventeen acres in area and twelve feet in depth—was constructed. This provided time to investigate and provide another method of sludge disposal for the Northeast plant.

The details of this extensive investigation—completed in 1957—have been previously reported.

Based on this investigation, Philadelphia decided to barge digested sludge from the Northeast plant to sea.

The "Sludge to Sea" program was initiated in 1981 by contracting for sludge transportation service. This contract featured five important specifications:

1. The unloading area was confined to an area of one square mile—ten miles off Cape May, N.J.
2. The percent solids in the sludge would be limited to 15%.
3. The contractor would be paid on a volume rather than weight basis.
4. The contractor must be adequately insured for this type of service.
5. The contractor was forewarned concerning the hazards of transporting sludge which produces an explosive gas.

During 1961, 1962 and 1963, digested sludge was pumped directly from the Northeast plant digesters to the barge docked at the Northeast pier—a distance of four thousand ft—and from there transported 110 mi to the unloading area.

Traveling time to the unloading area varied with weather conditions, but thirteen hours is a good average. The unloading time at sea averaged six hours which is quite lengthy. This was due to the construction of the barge which necessitated pumping the sludge overboard at sea.

In the first three years of barging, the digested sludge averaged 6.2 percent solids. In 1964, a dredge was purchased to enable the pumpage of thickened lagooned sludge to the barge. The dredge is a portable type which was transported overland, disassembled to the lagoon site and then assembled in one of our lagoons.

*Presented at 88th annual conference Pennsylvania Water Pollution Control Association.

**Chief Water Pollution Control Division, Philadelphia Water Department.

The dredge is so constructed that it can be—if so desired—moved from lagoon to lagoon or from one plant to another.

The dredge pump is rated at 4000 gpm at a head of 115 ft. The adjustable suction pipe is equipped with a cutting head to prevent large objects from entering the pump and to grind grindable material. It can pump sludge from a depth of twenty feet, although our normal operating depth is eight feet.

Our experience with the dredge has been favorable. We have been able to pump sludge of 10 to 15 percent solids, with little difficulty, a distance of 2000 ft to the barge at a rate of 3000 gpm. The use of the dredge has enabled us to reduce the number of barge trips and cut sludge barging costs.

The second step in Philadelphia's sludge disposal program was to determine, on the basis of operating experience and costs, if we should build and maintain our own barge or continue by contract.

This decision was made easier when sludge disposal needs were considered for Philadelphia's other two plants; namely, Southeast and Southwest. The solids removed at the Southeast plant are pumped five mi to the Southwest plant for treatment and disposal.

Originally, 375 acres were available for sludge disposal. However, the sale of this land for other uses, and the lagooning of the digested sludge from the Southeast and Southwest plants, reduced the area for lagooning in 1964 to approximately 175 acres. In addition, the city had been requested to make other areas available for the construction of the Delaware expressway and industrial development.

The request for other uses of the area originally intended for sludge lagooning accentuated a review and updating of the 1957 investigation and decisions for sludge disposal in Philadelphia. It was found that if the sludge barging contract could be increased to 70 mil gal per year and guarantee one contractor, at least, this amount for three years, the cost of barging by contract would be slightly greater than the annual cost if Philadelphia were to build and maintain its own barge.

The present annual sludge disposal requirements for Philadelphia's three treatment plants is 90 mil gal at 10 percent solids. Consequently, it was decided to:

1. Continue to contract on a three year basis.
2. Postpone building a barge.
3. Terminate lagooning of digested sludge at the Southwest Plant and provide sludge barging facilities.

This would reduce the cost of barging the Northeast plant's digested sludge and make the area, not in use as lagoons at the Southeast plant, available for other uses.

To insure that we will be transporting a 10 percent sludge to sea from the Southwest plant, a centrifuge station is planned. This station, which is in the advanced design stage, will be quite versatile. In addition to thickening digested sludge and removing excess solid in digester supernatant liquor before its return to the treatment process, this station will be piped to enable the thickening of raw sludge en route to the digesters. This will be an alternate use when not pumping sludge to the barge.

SUMMARY AND CONCLUSIONS

The favorable economics of barging to sea has solved our sludge disposal problem. This is further appreciated when one considers that we are now able to dispose of sludge at one-third the cost of sludge incineration, which was being given strong consideration.

Barging to sea has also made area available, originally set aside for lagooning of Southeast and Southwest digested sludge, for other purposes which we feel will be more valuable to the city.

PHILADELPHIA SLUDGE BARGING COSTS

	Volume (millions of gallons)	1,000 gallons	Solids	Dry ton
1961.....	28	\$5.92	6.20	\$22.90
1962.....	36	6.40	6.36	24.13
1963.....	53	4.70	5.94	18.97
1964.....	40	6.30	7.24	20.87
3-year contract:				
1965.....	50	3.73	9.50	9.42
1966.....	90	3.73	10.00	8.94
1967.....	90	3.73	10.00	8.94

Senator MUSKIE. Before you turn the slides off, may I ask the members of the Committee, our colleagues, if they have any questions based on these slides.

If not, then let's turn the slides off and turn on the lights. I think we have been more enlightened while we have been in darkness. [Laughter.]

Mr. Coulter is our next witness. Then after all of you have testified, I will invite questions. If I may remind our audience, Mr. Coulter is the deputy secretary of the Maryland Department of Natural Resources, representing Governor Mandel.

**STATEMENT OF JAMES B. COULTER, DEPUTY SECRETARY,
MARYLAND DEPARTMENT OF NATURAL RESOURCES**

Mr. COULTER. Mr. Chairman, members of the committee. First let me convey the regrets of Governor Mandel that he is unable to be here today. He is deeply concerned with the matter of dumping in the ocean and if it were not for the closing week of the Maryland General Assembly he would be here to testify in person, as he has done several times before.

Senator MUSKIE. Please convey our best wishes to him.

Mr. COULTER. Mr. Chairman, I have prepared a statement which I have attempted to keep brief but I believe it is still rather long and involved. I would like to submit that statement for the record and briefly summarize some of the high points contained in the statement.

Senator MUSKIE. Without objection, we will include your prepared statement in the record following your testimony.

Mr. COULTER. I believe it goes without saying and should be evident to all here that Maryland has a sizable stake in the purity and productivity of the ocean. Along these beaches millions of people vacation each year and the surf clams that come into Ocean City go into clam chowders all over the Nation.

I think the chairman will be especially interested in that although we are not in competition with Maine, the catch of lobster off the coast at Ocean City is increasing both in size and quality.

Senator MUSKIE. As a matter of fact, may I say that in both Maine and Maryland shellfish beds are being closed off to production because of this pollution problem. We could use the full production of the beds in both States to satisfy the appetites of this country, if we could get the production.

Mr. COULTER. Ocean City is known as the "white marlin capital of the world" and there is a thriving sport fishery that goes on over there. To the western side of the Delmarva Peninsula the Chesapeake Bay is one of the last, healthy, productive estuaries in the United States. We intend to clean up the spots where pollution has made its inroads and we intend to keep that bay clean. No one in recent years has suggested that sludge of any type be dumped into the waters of the Chesapeake Bay. There have been those from the Washington metropolitan area that have proposed piping the sewage from Washington, D.C., and the surrounding area to the bay but by and large we think too much of the bay and its bounty to give those suggestions any serious consideration.

The matter of dredging for harbor improvement and channels for shipping in the bay is another problem. We have distinct problems, one is the problem of so-called contaminated dredge spoil and the other is that of clean spoil. Taking them one at a time, when we speak of contaminated spoil we are talking of spoil that has been dredged from the bottom of places like Baltimore Harbor and has been highly contaminated with domestic sewage and industrial waste. I might point out that in former days of rather lax control the harbors and the estuaries to the bay served as nature's last barrier between the pollution that was coming in unchecked and the bay itself and much of the silt at the bottom of these areas has locked up and is holding that pollution. To simply dredge it up and move it into the heart of the bay we feel would be sinful.

In the past several years the State has taken some strong measures. The so-called dumping ground which is an area just to the north of the east terminus of the Chesapeake Bay Bridge has been closed and there is no more dumping of spoil material from Baltimore Harbor in that area.

The General Assembly has authorized the sale of \$13 million in bonds to build a confined disposal area for contaminated spoil. A site has been selected in the vicinity of Hart and Miller Islands which is just outside of Baltimore Harbor and engineering plans are going forward. In the meantime all of the dredging for places like Baltimore Harbor has been kept to a minimum, to those things that are absolutely essential for the continuance of the activity, and the dredge material is either stored in the harbor or taken to a place known as Pooles Island Deep. Pooles Island Deep, as its name implies, is a deep hole about 72 feet deep to the south of Pooles Island in the Chesapeake Bay. Before this site was selected studies were made and it was determined with reasonable predictability that the material deposited in this hole would remain there and not drift away. Furthermore, it is sufficiently removed from shellfish growing areas that again it was predicted it would not be a hazard, so that the minimum amount of material that must leave the harbor is going into that site.

The Department of Natural Resources, and for that matter, many agencies of the State, would prefer that there be no removal and no dredging of contaminated spoil material and disposal in Chesapeake Bay but we are forced to wait until the contained area is constructed before we can strictly apply that prohibition. In the meantime, we are keeping things to a bare minimum.

Now, with the so-called uncontaminated or clean spoil, I would like to make the point that even the moving of this material, if moved at the wrong time of the year or deposited in the wrong place, will cause difficulties.

During the widening and deepening of the C. & O. Canal extensive studies were made of the deposition of the relatively clean spoil that came from that area and was deposited in the Chesapeake Bay. The Natural Resources Institute over a 2-year study found that there were no long-range effects that they could identify. There was an immediate disruption of life at the bottom of the bay but the life balance very rapidly recovered. However, they did come up with a number of cautions and restrictions and those restrictions have to do with the place and the time and the safety zone between vital areas

that must be maintained between the site of dredge disposal. The State has adopted those recommendations and has asked the Corps of Engineers to abide by them and I am happy to say that the corps has agreed to do so in the necessary maintenance dredging.

Mr. Chairman and members of the committee, I would like to turn my attention to a very important problem and that is the problem of sewage sludge disposal. I think that the ultimate success of the Nation's water pollution control program, and certainly the success of our objectives in Maryland, depend on an acceptable and dependable way of disposing of the sludge that is removed during sewage purification. It has been pointed out there this morning that this sludge is the semisolid residue which contains the contaminants which have been removed during the purification process, and just as it makes no sense to polish up and clean up a garbage truck and send it back to pick up another load of garbage without thinking of what is going to happen to the load of refuse that was discharged, so it doesn't make any sense to continue to get water cleaner and cleaner and sewage purification works and forget this very important thing of what to do with the residue which is removed from the sewage.

Baltimore is faced with this problem like every other city. They have tried a great number of things since the establishment of that sewage treatment plant back in the early 1900's, they have tried drying it, they have tried making pellets out of it, they have tried storing it on the site; if the evidence can be believed they have tried dumping it into the Back River. None of these alternatives were acceptable to the city or the State.

Some years ago, in 1966, I believe, the city made application to the Federal Government for a system to barge its sludge to the sea, and they applied for a Federal grant for that system. The proposal was that barges would move to a dock to be built in the Back River near the sewage treatment plant, through Baltimore Harbor, up and through the C. & O. Canal and use essentially the same dumping grounds which you saw on the slide just a few moments ago. All parts of that grant were approved by the Federal Government with the exception of dredging a channel up Back River, and the Federal Water Pollution Control Administration very rightfully, I believe, refused to use sewage treatment plant grants to dredge that channel.

In the meantime, the State Board of Natural Resources, which was the forerunner of the present Department of Natural Resources, looked into the matter to determine first what assistance, if any, the State should give this proposed system and, second, what kind of restrictions the State should make if the system went into operation. We studied it monitarily making use of the expertise of people like Dr. James Carpenter of the Chesapeake Bay Institute and Dr. Eugene Cronin of the Natural Resources Institute, as well as the other people that we could bring together, and we felt that Maryland, being a very small State, could not even attempt to believe that it would exist in a vacuum on the east coast, so we looked at the problem up and down the east coast. Our humble estimates are that by the turn of the century some fifty million people could have reason to be dumping sewage sludge into the ocean, and I would like to point out that our committee generalized only on sewage sludge. Sludges that come from an industrial process we do not believe could be generalized on in any way, so we are talking only about sewage sludge.

We believe that these fifty million people would result in a dumping on the east coast coastal waters some five million pounds of sewage sludge per year. Right at the outset we determined that no floating material could go into the ocean without expecting to see a fraction of that ending up on the beaches, some beaches somewhere. So it was our thought immediately that no floating material should go into the ocean.

We found that on examination of a great number of factors, including heavy metals, bacteria and transparency, biochemical oxygen demand, secondary production of demand, that all of the factors that we could bring into the hopper, using as our criteria, productivity of the water and recreational values; productivity in the way of shellfish and fishing, that oddly enough in either this quirk in our arithmetic or it just came out this way, for most of these materials a pollution ratio of 1 to 10000 was needed for digested sludge to maintain the standards which we had set for shellfishing, bathing and so on.

Along with the chairman's remarks this morning about standards versus stipulations, we believe that if this practice is permitted it is very important to set stipulations on the practice itself and not merely rely on standards. For instance, we considered what would happen if the sludge from one and a half million persons per day was dumped by barge, or what would happen if it were transported to the ocean by pipeline, and we found to achieve these standards that we talked about that the barge would have to discharge over a distance of some 10 miles, and even then if a barge each day discharged we would result in something like three continual hot spots in an area where our criteria would be violated.

Looking at pipelines, we found that pipelines actually had advantages over barges, we could very carefully control where the material would go, at what rate it would go, if it would be dependable during all times of the year and during all weather, and it would give us a better opportunity to monitor and would leave out the uncertainties of unscrupulous barge captains and so on and so forth.

So I am suggesting to the committee that perhaps the matter of pipeline should not be left just to permits on shores but perhaps should be included in this legislation on dumping into the sea because the pipelines do have advantage.

One final thing I would like to call to your attention, our committee felt that up and down the east coast of the United States, just on a straight economic basis using dollars today, there is no section of the shoreline that could be sacrificed for the disposal of sludge. The most expensive alternative of dumping at sea, we came up with a figure of something like \$100 per ton, and even at that high cost there is no section of shoreline that doesn't have greater value for recreation and for other things so that no part of the shoreline could be sacrificed in our opinion for this purpose.

Senator MUSKIE. And that is on a straight economic basis?

Mr. COULTER. That is on hard dollars let alone the social and ecological values involved.

Mr. Chairman, at the conclusion of our studies in the State we found that the disposal of sludge under carefully controlled conditions in the ocean was feasible. But, also, with an eye to the rising concern for the disposal of this kind of material in the ocean, because of rising costs and because of the very difficult problem the city would face if they dredged Back River to the stipulations of the

State, both the State and the city have actually lost enthusiasm for this project and we are seeking other alternative ways for disposal of the sludge.

Before summarizing, Mr. Chairman, if I could take just a few moments and address some remarks to a piece of proposed Federal legislation, the Marine Resources Act of 1971, and I apologize that this is not with the statement that I gave but with the permission of the chairman I will give you a copy to the committee for inclusion in the record.

I know that there are a number of pieces of legislation before the Congress, I believe that the remarks that I have to make here would represent our position in a rather general way although it is geared specifically to the Marine Resources Act of 1971.

Senator MUSKIE. Thank you very much, Mr. Coulter, for your excellent and very constructive testimony.

(Secretary Coulter's prepared statement follows:)

PREPARED STATEMENT OF JAMES B. COULTER, DEPUTY SECRETARY, MARYLAND
DEPARTMENT OF NATURAL RESOURCES

Senator Muskie, members of the Committee, I am James B. Coulter, Deputy Secretary, Maryland Department of Natural Resources. Governor Mandel has asked me to convey his regrets, and assure you of his personal concern for the problems created by ocean dumping of waste materials. If it were not for the demands of Maryland's General Assembly, now in the closing weeks of its 1971 Session, Governor Mandel would be here to testify in person.

I know the committee is well versed on this subject and familiar with the findings and recommendations of such reports as "Our Nation and the Sea" by the Commission on Marine Science, Engineering and Resources. Also, I know you are acquainted with the Presidential message to Congress transmitting the "Report of the Council on Environmental Quality on Ocean Dumping." Those reports accurately depict the problem facing the nation and the world.

Rather than repeat facts already available to the committee permit me to use this time to highlight briefly Maryland's evaluation of the effects of ocean dumping on its coastline and marine environment. I think the committee will be interested also in some of the measures we have considered in Maryland—some of which were rejected and some adopted.

Maryland has a sizable stake in the purity and productivity of its coastal waters. Each summer, several million people vacation along the superb beaches of Ocean City and Assateague Island. The waters offshore are famous worldwide for White Marlin, and charter boats are a thriving industry. Last year, more than 22,887,000 surf clams, landed at Ocean City, went into clam-chowders in much of the nation.

While the lobster harvest hardly compares with that of the Chairman's home State of Maine, catches are made, and in fact, the number of lobsters being caught in Maryland Waters is increasing each year. In two years, 1967 to 1969, for example, the catch increased from 19,000 pounds to 26,500 pounds.

The Chesapeake Bay is one of the last healthy, productive estuaries in the nation. We intend to keep it that way. We are cleaning up those Bay locations where pollution has made an inroad. And with good reason.

We intend to protect and enhance a resource that last year produced seafood with a dockside value of more than \$17 million, provided employment for 9,000 watermen and 20,000 persons in seafood processing and marketing activities.

Because of the Bay and its tributaries, Maryland leads the nation in the production of oysters, soft-shell clams and striped bass. It is second in blue crabs.

Few places in the world offer more attraction for recreational boating and sportfishing than the Chesapeake.

In recent time no one has even suggested dumping sludge or solid waste into the Chesapeake Bay. Some people have suggested piping waste into it from the Washington Metropolitan Area. By and large the people of Maryland think too much of the estuary and its bounty to give that suggestion any serious consideration.

Disposal of spoil from dredging channels and harbors for ships is another matter. The spoil falls in two categories, contaminated and clean. Both types cause problems but the contaminated spoil is by far the most dangerous.

The sediments at the bottom of Baltimore Harbor contain a medley of chemicals and heavy metals. Over the years the harbor has served as nature's barrier by trapping much of the pollution that flowed out of drains and came unchecked down the Patapsco River. The protection afforded by nature would vanish if the deposits were dredged up and moved into vulnerable portions of the Bay.

In recent years several actions have been taken. The practice of barging spoil from Baltimore Harbor to the "dumping ground," just north of the east terminus of the Chesapeake Bay Bridge has been stopped. The General Assembly authorized the sale of \$13 million in bonds to construct a contained disposal site. A study has been made and a site adjacent to Hart and Miller Islands near Baltimore has been selected. The Board of Public Works has authorized design of the containment area.

Previously, the Board created a Commission on Submerged Lands to pass on all major dredging projects. Only essential, high priority projects in Baltimore Harbor are permitted pending construction of the contained area. Spoil from the projects that are permitted is stored within the harbor or shipped to Pooles Island Deep which, as its name implies, is a deep hole near Pooles Island. It is sufficiently removed from shellfish growing areas to eliminate that problem. Studies have shown that with reasonable predictability the spoil deposited in the deep will not drift. The Department of Natural Resources would prefer to ban all overboard disposal of contaminated spoil in the Chesapeake Bay, but that restriction cannot be imposed until the contained area is built.

So-called clean spoil is dredged material that has not been contaminated by municipal and industrial wastes. The dangers and uncertainties of dumping clean spoil are far less than those associated with contaminated spoil. Nevertheless, if dumped at the wrong place or during the wrong time of the year significant damage can occur.

During the deepening and widening of the Chesapeake and Delaware Canal approach, 1965-1967, the Natural Resources Institute thoroughly investigated the effects of spoil disposal. They found some temporary disturbance but noted rather rapid recovery of the normal life balance. The investigators concluded that there were no gross effects, but recommended that:

(1) a safety zone of 500 feet for each foot of expected deposition be provided between the receiving area and any shellfish beds or other areas of special significance;

(2) to protect fish eggs and larvae as well as other biological activities in the Bay, the dredging should be conducted during the months of February-March or September-October; and

(3) that the Corps obtain and provide to the State, accurate information on the deposition and movement of the spoil.

The State has stipulated and the Corps of Engineers has accepted those three conditions for overboard disposal of spoil from maintenance dredging in the upper Chesapeake Bay near the Chesapeake and Delaware Canal approach channel.

Like most major cities, Baltimore is faced with a perplexing sludge disposal problem. There are only three places for the stuff to go—in the air, land, or water. In each of those areas serious potentials for pollution exist.

Baltimore has tried drying, lagooning, making fertilizer pellets, storing on the grounds, giving away for soil conditioner; and, if the evidence can be believed, dumping the sludge into Back River. None of the solutions, including the last one mentioned, has worked to the satisfaction of the City or to the people living near the plant.

In 1966, Baltimore applied for a Federal Grant to help finance a system to barge sludge to sea. Barges were to move through the Chesapeake and Delaware Canal and dump near the area used by Philadelphia. The Federal Government approved all parts of the grant including the loading dock and the barges, but it balked at financing the dredging of a channel from the harbor up Back River to the sewage treatment plant.

There followed a series of negotiations with the aim of securing an overland pipe route to the inner harbor—all to no avail. The possibility of using the right-of-way that carries treated effluent to the Bethlehem Steel mill at Sparrows Point was explored. Thought was given to combining some of the Bethlehem waste with the sludge and barging it from a joint facility at Sparrows Point, but no agreement was reached.

Meanwhile, Maryland's Board of Natural Resources, the forerunner of the present Department of Natural Resources, looked into the matter to determine the extent of State assistance that might be provided and the stipulations the State might impose if the system went into operation. The Board appointed an expert committee to study and report on the problem. Heavy reliance was placed on the expertise of Dr. James Carpenter of Johns Hopkins University and Dr. Eugene Cronin of the University of Maryland.

The key to the ultimate solution of Baltimore's problem and, in fact, the overall success of water pollution control lies in the proper disposal of sludge. Sludge in this context is the semi-solid residue containing contaminants removed during the purification of domestic sewage.

In contrast with domestic sewage sludge, sludges arising from chemical processes present unique problems based on the composition and toxic elements of the specific sludge. The Board's committee could not generalize on the disposal of industrial sludges at sea. Rather the committee limited its consideration to sewage sludge.

They estimated that by the year 2000, a total of 50 million people might be disposing of five billion pounds of sludge per year in the offshore waters of the East Coast. But the committee found that there is no section of coastline on the Eastern Shore that profitably could be sacrificed for sludge disposal. The most expensive alternate method might be expected to run as high as \$100 per ton, but the shoreline is far more valuable for recreation than for sludge disposal even at that high cost.

At the outset, it was determined that floating material could not be dumped; because no matter how far to sea it was taken, floating material would almost certainly end up on the seashore somewhere.

Calculations were made to determine the dilution needed to bring the concentration of sludge down to levels considered acceptable for recreational waters. For bacteria, turbidity, algae, fisheries, transparency, biochemical oxygen demand, secondary production of BOD and heavy metals, using what was judged to be safe assumptions, it was calculated that a volumetric dilution of one part digested sludge to ten thousand parts of seawater is needed.

Some fertilization of the continental shelf would be desirable and it could be provided by sewage sludge. However, residence time of water on the shelf is about 1.5 to 2.0 years, and sustained use of the shelf by 50 million people would result in overfertilization. Should that occur, stopping discharge over the shelf for a period of years would permit recovery. Dilution is greatest at the mouths of estuaries, but from what is known now, it is not great enough to take the sustained discharge of sludge from 50 million people. Even there, recovery periods might be needed.

Of the two methods of conveying sludge to sea, barges and pipes, barges will require the most control. A barge carrying the sludge produced daily by 1.5 million people discharging over a 10-mile run might be acceptable. Even so, one such barge discharging every day might be expected to produce three patches where the concentration of sludge is likely to be greater than one part sludge in ten thousand parts seawater. If discharges is far enough out, and remote from existing ocean outfalls, these patches or hot spots as they are sometimes called, would not be damaging. However, if barges were dumped too fast, too close to shore, or too close to effluent outfalls, undesirable results might be observed.

In pipes, the sludge could be given an initial dilution of 100:1 for pumping and distribution through nozzles at the bottom of the ocean. Calculations of the plume effect as the sludge-water mixture rises through the seawater shows another 100:1 dilution. Thus, a dilution ratio of one to ten thousand is achieved almost immediately. Using the most conservative factors, the sludge from 1.5 million people, diffused from eight nozzles at a depth of 50 feet, would give the desired dilution in less than 10 miles of travel. The advantages of pipelines over barges are that:

- (1) there is positive control over the point at which the discharge is made,
- (2) the pipeline works in all weather, fair or foul, and
- (3) during the critical summer months there is a good possibility that the sludge plume would never reach the surface.

The committee summarized that the continental shelf can safely be used for the disposal of sludge during the next 10 to 20 years if the practice is carefully controlled. However, if the shelf is used heavily for this purpose, the load may become so great that the shelf will be overfertilized. In that event, ocean disposal would need to be suspended for a period of time or some of the sludge

would have to be transported farther out to sea beyond the continental shelf. While some fertilization of the continental shelf seems to be desirable, the effects of sludge disposal should be observed carefully as the practice develops. These observations should then be used to make any necessary modifications to prevent the development of excessive hot spots or the undesirable consequences of general overfertilization.

The committee believed that initial control measures should include:

1. Careful regulation of the discharge points for barges or pipelines.
2. Control over the rate and distance traveled during dumping.
3. Prohibition against the discharge of any floating material.
4. Careful evaluation of the effects on the waters of the continental shelf and the beaches with prompt relocation of the dumping ground (probably moving further out to sea) if adverse conditions begin to develop.

In 1969-1970 Maryland's General Assembly enacted legislation authorizing the State to finance up to eighty per cent of the cost of dredging Back River to accommodate the sludge barges. However, with the growing concern over ocean dumping and faced with rising costs of dredging, barging, and construction, both the City and the State have lost enthusiasm for the project. Methods of disposal with other solid wastes or disposal on land are being considered at this time.

SUMMARY

The quality and productivity of the ocean are vital to many of Maryland's interests. The State's coastal waters have remained relatively free from all forms of pollution. As inland water pollution control becomes more strict, however, waste producers may turn to ocean dumping to solve their problems.

Unchecked ocean dumping would create conditions harmful to Maryland. The State could not exercise effective control over this practice. Accordingly, I urge the Congress to pass a potent, far-reaching enforceable law to regulate transportation of waste materials from the United States for dumping in the ocean. The law should provide that dumping without a permit is illegal and should provide authority for regulations governing the places and conditions under which wastes may be dumped in the ocean.

On the other hand, I urge just as strongly that Congress give the administering agency the discretionary power to permit dumping when no harm will be done and to actively seek and encourage dumping in those instances where the marine resource will be benefited.

Sewage sludge must be returned to nature in one of three ways, incineration followed by ash disposal, land disposal or ocean dumping. By and large lakes and estuaries are too sensitive to permit their extensive use for this purpose. On the other hand, provided the application of science and strict control, ocean dumping ranks with land disposal or incineration as an acceptable means for returning municipal sewage sludges to nature.

(Subsequently to the hearing Mr. Coulter provided the following supplemental statement:)

EXTENSION OF STATEMENT BY JAMES B. COULTER, DEPUTY SECRETARY, MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARINE RESOURCES ACT OF 1971

Mr. Chairman, for consideration of the Committee, I offer the following comments regarding the specific provisions of the proposed "Marine Resources Act of 1971."

I am pleased with the purpose of the act. Pollution of the ocean would be particularly harmful to Maryland; yet Maryland cannot regulate activities on the high seas. Clearly the control of ocean discharges is a job for nations and international governments.

The straightforward language of section 4 sets forth a clear basis for regulating the transportation and dumping of materials in the ocean. As I will describe later, the Congress may wish to modify the language and make it clear that the act applies to the oceans and open coast lines only.

Penalties provided in section 6 are severe, but no more severe than the nature of a violation justifies. In my opinion, the existing Federal water pollution control law would be improved if it incorporated the strategy for civil and criminal procedures set forth in this act.

I object to the provision in subsection 3(e) which exempts employees of the Federal Government from the penalties of the act. Past performance of Federal employees does not give a picture of dedicated infallibility that would warrant that confidence. Immunity to penalties would not work to foster a personal responsibility or obligation to prevent unregulated dumping in the ocean. Also, if similar immunity on a reciprocal basis was included in international agreements, such agreements might lose much of their force and effect.

Section 5 provides for orderly administration of a regulatory program. While regulation is necessary, it can make a limited contribution only to a positive waste management program. It is imperative that the Federal Government use its powers and vast resources to find ways of solving problems. The present trend of State and Federal legislation toward banning specific products and making it a "no-no" to use various segments of air, land or water for waste discharges will create a costly, unworkable situation.

Elements of a positive program are contained in subsections 5(e) and 5(g). I would like to see those thoughts strengthened and brought into focus in a separate section. I suggest that Congress direct the Administrator to identify areas in the territorial waters of the United States where, under duly adopted regulations, dumping would be acceptable without requiring individual permits. Such areas would be designated only after careful study, making use of the resources of Commerce, EPA, and other Federal agencies. The regulations would set forth the materials that could be dumped, and the conditions under which the site could be used. Violation of the regulations would subject the offender to the penalties of section 6.

The advantages are numerous and powerful. Control would be strengthened and simplified if ocean dumping were limited to specific locations. Monitoring would give early warning of possible adverse effects and the regulations could be adjusted or the dumping ground relocated. Sites would be selected in advance to avoid damage to the ocean and possible beneficial aspects could be exploited. The Nation would be provided with at least one acceptable alternative for disposing of waste materials that simply must go somewhere.

Subsection 7(c) attempts to clear up (for this law at least) the overlapping jurisdiction and confusion that has been generated by the decision to use the Rivers and Harbors Act of 1899 as a modern basis for a water pollution control permit system. It is doubtful that the purpose has been achieved or that it will be until the authority contained in section 13 of the 1899 act is transferred to EPA. However, for the purposes at hand, the problem would be greatly minimized if the proposed "Marine Protection Act of 1971" were to be limited to the open ocean, rather than including all waters where the tide ebbs and flows.

Under the definition in subsection 3(b), the Chesapeake Bay and the tidal portions of its tributaries would fall under the provision of the act. This would include all of what has been designated as tidal waters under Maryland law and regulations. Furthermore, subsection 2(c) defines "material" to include dredging and filling and many other things now regulated by the State and Federal Governments. For instance, Maryland's law governing the dredging and filling of State wetlands would be complicated and confused by the proposed Marine Protection Act of 1971.

Likewise, the State's dredge-spoil program would be slowed down and left open for another round of discussion and perhaps veto by still another Federal agency. Jurisdiction over and legality of the program in which old oyster shells are dredged and relocated to enhance production of oysters would be open to question. Creation of fish havens by the State using material placed in the Bay would be subject to EPA permit. The waterway improvements program pointed toward improvements for recreation boating would be under question from still another agency.

The Marine Protection Act of 1971 would not add one iota to the level of protection now afforded the Bay through State and Federal laws. It would, however, add another layer of administrative actions which would lead to inefficiencies and confusion.

While the Marine Protection Act of 1971 would provide much needed protection for the Ocean and perhaps for the Great Lakes, it would add nothing but confusion in the case of the Chesapeake Bay and similar tidal waters now under close protection provided by existing Federal and State laws. Therefore, subsection 3(b) would greatly enhance the purpose of the proposed law if it were rewritten to narrow the applicability of the act to the open ocean and the open coastal waters. I am not informed on the present status and effectiveness of laws regulating dumping in the Great Lakes, and therefore, I am not qualified to

comment on the need to include the Lakes in the definition. However, it would seem that the logic would be the same. The Marine Protection Act of 1971 will serve a highly useful purpose if it fills a legal vacuum. However, to the extent that it duplicates existing law, it will increase confusion, but it will do nothing to add to the protection of the nation's marine resources.

Mr. COULTER. I have just a few more remarks, if I may, Mr. Chairman.

Senator MUSKIE. Yes, sir.

Mr. COULTER. First, on the Marine Resources Act, we are very pleased with the purpose of the act. The pollution of the ocean is vital to the interest of Maryland, or the control of it and Maryland has no way of controlling what goes on on the high seas and, therefore, we believe clearly that ocean discharge is a problem for National Government and international governments and not State government.

We like the straightforward language of section 4 which sets out a clear basis for regulation of dumping in the ocean. I wish that the Congress would consider modifying that language to make it clear that it is applicable to the ocean itself.

The penalties provided in section 6 are severe, but, in my opinion, the existing water pollution control law would be greatly improved if it incorporated the strategy of civil and criminal penalties that are in this proposed Marine Resources Act.

Mr. Chairman, I object very strongly to the provisions in the act which would exempt employees of the Federal Government from the penalties of the act. Past performance of Federal employees does not give a picture of dedicated infallibility that would warrant that competence. Immunities to penalties would not work to foster a personal responsibility or obligation to prevent unregulated dumping in the ocean. Also, a similar immunity on a reciprocal basis was included in international agreements; such agreements might lose much of their force and effect.

Section 5 provides for an orderly administrative regulatory program. Gentlemen of the committee, I would like to point out that it is imperative that the Federal Government use its power with its vast resources to find ways of solving the problem. The present trend of State and Federal legislation toward banning specific products and making it a no-no to use various segments of air, land, or water for waste discharges will create a costly, unworkable situation.

Elements of a positive program are contained in subsection 5(e) and 5(g). I would like to see those thoughts strengthened and brought into focus in a separate section. I suggest that Congress direct the Administrator to identify areas in the territorial waters of the United States where, under duly adopted regulations, dumping would be acceptable without requiring individual permits. Such areas would be designated only after careful study, making use of the resources of commerce, EPA, and other Federal agencies. The regulations would set forth the materials that could be dumped, and the conditions under which the site could be used, and violation of those regulations would then be subject to the same kind of penalties as those contained in section 6.

I think the advantages for that are many; I don't think we need to dwell on them here.

Section 7(c) of the Marine Resources Act attempts to clear the confusion that has been generated by the decision to use the 1899 act as a

basis for a modern water pollution control permit system. Frankly, it is doubtful that this purpose has been achieved, or that it will be, until the authority contained in section 13 of the 1899 act is transferred to the Environmental Protection Administration. We see no hope.

I do point out, though, that for the purposes at hand the problem would be greatly minimized if the proposed Marine Resources Protection Act of 1971 would be limited to the open ocean rather than including all waters where the tide ebbs and flows. This is important in Maryland because within the Chesapeake Bay we have very tight control over many activities that are going on, under both Federal and State law, and these activities include such things as dredging old shells of oysters and replanting them on beds that are not subject to MSX; a waterway improvement program for recreation, a very stringent wetlands control law that controls all dredging and filling of State wetlands that is now subject to comparable concurrence, at least, with Federal agencies.

My thought, Mr. Chairman, is by making this bill extend inland to waters which are already covered by Federal and State laws that we may be creating some confusion and overlapping and not giving one iota more protection to the oceans or to the marine resources.

With that, thank you, sir, I will conclude.

Senator MUSKIE. Thank you very much Mr. Coulter, for your testimony. I wonder if you would extend your closing comments to the Great Lakes.

Mr. COULTER. Yes, sir, I would. There was a time in my short life when I knew something about the Great Lakes but at present I am really not informed on the status or the effectiveness or the laws regulating the Great Lakes.

I think the same rationale should apply that the Marine Protection Act of 1971 will serve a useful purpose if it fills a legal vacuum, but that it will tend to create some more undesirable confusion if it merely overlaps the existing law. Whether that vacuum does or does not exist on the Great Lakes, I cannot say at this time.

Senator MUSKIE. Thank you very much for your excellent testimony.

I would like at this point, to include in the record a letter from Representative William T. Poulterer of the Delaware House of Representatives. Mr. Poulterer is chairman of the Environmental Control Committee of that body.

(Letter follows:)

HOUSE OF REPRESENTATIVES,
STATE OF DELAWARE,
Dover, Del., April 6, 1971.

HON. EDWARD S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution,
U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: Please add the following comments to the official record of the March 26 hearing conducted by your subcommittee on the subject of "ocean dumping".

As a professional Delaware River Pilot, having been engaged in that occupation for the last fourteen years, I have a working knowledge of the practical problems involved in the enforcement of any specific limitation on dumping off our coasts, such as, a ban on dumping within 100 miles of the U.S. Coastline. I strongly favor such a regulation, but I believe the enforcement procedures must be clearly spelled out to assure compliance!

For years I have observed the barges being towed down the Delaware River from Philadelphia and Camden to the disposal site ten miles off shore. If the dump site is moved further off the coast, any attempt to provide either escort

by another vessel, or to place an inspection officer on each tug, would be a tremendous expense, and also very ineffective, in my opinion. These barges are towed out in the middle of winter, in all types of weather, and often during hours of darkness. Many times an escort would be impractical because of the weather, and often an inspector placed on board the towing vessel would not have any method of verifying the vessel's position, other than trusting the word of its operators.

One foolproof, inexpensive method does exist for determining if the dumping takes place in the required area, that is, to require every barge engaged in such dumping to be fitted with a sealed recording fathometer, which would be activated when the pumps are running to empty the barge. This sealed fathometer could be opened and the graph examined by an inspector of the U.S. Coast Guard, or other agency, when the vessel returned to port. By comparing the recorded depth of water during the dumping operation with the charted depth in the disposal area, the location of the disposal could be verified in general, and in particular, that it was outside the continental shelf. In addition to this requirement, spot checks could be made by helicopter, by the Coast Guard, to double check disposal location.

I believe the enforcement procedure outlined above, that is the use of the sealed fathometers, is currently used in one or more of our southern or Gulf Coast ports to insure ocean dumping in the proper locations. I hope you will provide adequate enforcement provisions in any regulations or legislation adopted, and that you will fully consider and investigate these recommendations.

Respectfully,

WILLIAM T. POULTER, III,
Chairman, House Environmental Control Committee.

Senator MUSKIE. Now I must apologize to the following witnesses, including Mr. Sullivan, because I must leave to get back to Washington for another commitment. I especially regret that I will not hear the fishermen, the clambers, and seafood processors, and the representatives of the tourist industry because it is really for the purpose of hearing your testimony, that this hearing has been especially set up. Nevertheless, your testimony will be on the record, we will read it, and be enlightened by it, I am sure.

As I leave I would like to say that the members of the Committee join with me in extending great appreciation for the facilities and the preparations that have been taken to make the hearing so rewarding, and I would like to thank Mayor Johnson, City Manager Bayard Coulter, and Chief of Police William Marvel for their cooperation.

And I think I ought to comment on the sign outside. I have been told that the reason my name appears above that of Senator Boggs is that John Brown, who is the custodian of both the city hall and the sign board, is the only Democrat in Rehoboth. [Laughter. Applause.]

Senator Boggs. Mr. Chairman, thank you.

You will notice that on our desk we have a Rehoboth Beach ash tray—a very beautiful ash tray. On the back, it says, "Subcommittee Hearing, Rehoboth Beach, March 26, 1971."

On behalf of the mayor and many people who helped arrange the hearing, I would like you to have this as a souvenir in recognition of your visit with us today.

Senator MUSKIE. It is my birthday in 2 days. [Applause.]

Senator Boggs. Let me advise those in attendance that it is the subcommittee's intention to continue until about 12:30, then take a break for lunch, and return at 1:30.

Did you finish, sir?

Mr. COULTER. Yes, sir, I had.

Senator Boggs. While Mr. Sullivan is returning, I would like to note that we have received many prepared statements from persons not on the witness list. I am told by the staff that the number is now 12. In addition, there are many others in attendance who may like to speak. May I suggest this: all prepared statements, including those submitted to the committee by April 9—2 weeks from today—will be included in the hearing record.

Secondly, if time remains at the end of the testimony from scheduled witnesses, we will hear from anyone who wishes to testify on a time-available basis. We want to cover all that we can before concluding the hearing at 5 o'clock.

Our next witness is Richard J. Sullivan, commissioner, Department of Environmental Protection, State of New Jersey, representing the Honorable William T. Cahill, Governor. We are honored to have you here, Mr. Sullivan. I hope you will give our best regards to Governor Cahill.

STATEMENT OF RICHARD J. SULLIVAN, COMMISSIONER, NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

Mr. SULLIVAN. I certainly will.

Senator Boggs. You may proceed; we will ask questions when you conclude.

Mr. SULLIVAN. Very good.

Gentlemen of the committee, I will in the interest of time simply summarize and paraphrase the statement I have submitted for the record.

As Senator Case indicated earlier there are immense quantities of these wastes being dumped in the ocean every year. It seems that our coastline is the most popular one on the eastern seaboard, and while I have reason to be proud that New Jersey is first in many respects, we don't want to be first in this contest.

Governor Cahill, about a month after he came into office last year, publicly opposed the continuation of the dumping practice of putting toxic materials and sewage sludge in the ocean—and that remains his position.

Essentially, we are opposed to the practice for three reasons, which I will not detail because ample testimony will be provided by others on these subjects. First is the obvious destructive effect upon the marine environment itself; second is the threat upon the 120 miles of beautiful beach front that New Jersey is proud to have as a natural asset. And while the scientists argue as to the precise effects the current practices are having on this beach, it seems to me to be no answer to say that all the facts are not in because the threat of this damage is great and the only benefit from the current practice is one of convenience.

The third reason is a little more subtle; it gets down to the resource mismanagement of the whole practice. We still have with us the idea that we can throw our wastes away whereas actually the truth is there is no place to throw them. We are talking about taking materials that ought to be returned to the cycle of nature or to the cycle of manufacturing consumption by man but which instead are being thrown into the ocean. It seems to me that the principal technological need in

this whole area, and the area that I would strongly urge the maximum amount of Federal resources be made available, is to devise means to separate out from these sludges the organic components, the chemicals, the heavy metals, to return the organics to the soil and to return these other substances back into their industrial processes. There has been no incentive to do this in the past because there has been a barge waiting at the dock to take them out and put them in the ocean.

To give an illustration of what I think is the fundamental absurdity of the present system: We now have in the design stage in New Jersey \$300-million sewage treatment plan to be constructed in the city of Newark to serve our heavily populated metropolitan area. The function of this plant, as in the case of all sewage treatment facilities, is to accept all the wastes of the community and separate the clean part from the dirty part. The clean part will go into New York Harbor. Then will we—as we do now—take the dirty part and move it 12 miles away and put it back in the water? Now, whatever the precise effect upon a community of this practice, it has to be a preposterous system of managing waste. If we actually chose to dispose of the waste in this way, we would be much more honest about it if we forgot the \$300-million treatment plant and built a pipeline that carried the raw waste 12 miles to sea, which we probably could do for less than a third of the costs.

One of the top priorities of our State administration the past year has been the protection of marine resources. The political processes have even allowed us to come up with a statute under which State government supercedes local municipalities in the zoning—land-use requirements for our coastal marshes—precisely because we are coming to believe that they are more valuable to us in their natural conditions than they are filled up wall to wall with marinas and restaurants over looking the water.

We have a very strong enforcement program in New Jersey; there is more pollution control litigation in our State than any State in the Union. Our voters have given us a substantial bond issue to help us construct these treatment facilities. In short, we don't want this entire program frustrated or negated by a continuation of the present primitive practice of putting our wastes a short distance off the coast.

Let me talk briefly about the alternatives. As usual, they are not very good either. The story of our life in environmental protection is a continuing need to select from among a series of unacceptable alternatives. We don't need any more incinerators in New Jersey, however efficiently they are constructed. Our air is now burdened with a level of pollution that it cannot accommodate. Yet, it is our judgment that to incinerate these wastes would be preferable to dumping it into the sea. Disposal by land is available in certain locations. We have a crowded State with a lot of people in small areas; available landsites are diminishing in number for sludge or for solid wastes and that fact may make the disposal of solid waste a much bigger problem than air pollution in the near future unless we are more attentative.

Furthermore, while there are those who advocate the use of sludge to replenish the soil, I can assure you that if the sludge from some of our existing treatment plants, including the big one at Newark, were put in the soil, it would kill everything in sight. This is not returning to nature what was there; this is giving a dose of pesticides, chemicals, heavy metals, other things that plantlife can do without.

Over the longer term—and I consider this to be the principle of our whole inquiry to the system—the only method that is acceptable is the treatment of sewage sludge as a resource that must be refined and separated and put back in the system. In the meantime, incineration is preferable. Because of this reason we have notified all of the operators of treatment facilities in New Jersey, and under our Federal funding we will not approve any grants for the construction or enlargement of treatment facilities if they provide for ocean disposal as a means of sludge removal. This means that in our State where we will experience the first half of this decade a mass of construction programs because of the availability of State funds, that we will phase out the use of ocean dumping as the regular method by our big municipal treatment facilities.

Both Senators from New Jersey have introduced legislation on this subject. Generally we favor the approach taken by both. We think that the Congress should now enact controls that would prohibit 5 years from now the use of the ocean as a waste depository.

We believe further that in the interim the U.S. Environmental Protection Agency should have the authority by the permit system to regulate the use of the ocean for temporary dumping purposes. We think it should also have the authority to ban the disposal in the ocean of certain substances deemed especially harmful. We think that insofar as possible, and as soon as possible, during this 5-year period all wastes should be disposed of no closer than 100 miles at sea.

I have listened to the scientists talk to this question. I am mindful that we lack knowledge as to what perils this would create to the marine environment at that location, but at least we would have the protection of the added distance and the greater depth.

There are two problems I would like to call to your attention that we find with the legislation introduced by our Senators, however. It is not possible to pass a statute and have on the effective date an outright ban on the disposal of waste within the 100-mile limit. If we set up a 100-mile limit because of the greater distance to travel, because of fewer days in the year these vessels can be used, some of the vessels now in use couldn't go that far at sea; it would simply be a physical impossibility to put them 100 miles at sea the moment the act became effective.

But second—and this goes back to the point on which Senator Buckley made comments earlier—if the legislation deals with the prohibition of wastes of any kind going into the ocean, it could be deemed a prohibition against the treated water from sewage treatment plants going into the ocean. The question often is asked, "Should we put the treated waste, the treated effluent from our plants along the shore, into the ocean or not?" But the real question is not this one; the real question is, After a high degree of treatment, should we put the cleaned up water into the ocean or should we put it in the bay? These are the choices.

Our choice is for the ocean because of greater dilution, but in all cases requiring a high degree of secondary treatment. We interpret some of the language in these bills as prohibiting the use of the ocean for disposal of these effluents. Actually, wherever you put it, it ends up in the ocean anyway.

We think the Congress is the appropriate agency to pass the ground rules and we earnestly hope that legislation will be produced soon that

will deal with this problem that probably threatens my State more than any other. However, if, for some reason, it is not possible to produce legislation, we will go as far as our legislature and the courts will allow us. We are now considering legislation in which we would regulate the loading of vessels with wastes destined to go to the ocean. We are not entirely sure that we have jurisdiction to do this, but we think the problem is serious enough that we ought to give it a try. Our attorney general right now is also examining into the question of our standing to seek injunctive relief against certain practices of ocean dumping that we think should be changed immediately.

The place, the proper forum for the resolution of the question of how we should control, is the Congress, and we hope that you gentlemen in your deliberations can produce a piece of legislation acceptable to the Congress that will give us the degree of protection that is required.

Thank you, sir.

(Commissioner Sullivan's prepared statement follows:)

PREPARED STATEMENT OF RICHARD J. SULLIVAN

Each year almost 5 million tons of sewage sludge and toxic wastes are dumped into the ocean waters off the coastline of New Jersey. This makes our shore the most popular waste dump on the eastern seaboard. Ocean dumping is a primitive, insensitive, and completely unacceptable method of waste disposal. In fact, this is not waste disposal, it is waste relocation.

This practice is unacceptable to us for several reasons: First, it is destructive of the immediate marine environment itself. Ample testimony has been, and will be, given by informed scientists as to the nature and degree of the harm being done; but there is no argument that it is destructive.

The second reason for our opposition to dumping is the danger it represents to our surf waters and beaches. New Jersey has more than 120 miles of some of the finest ocean front beaches in the country. The thought that this magnificent, refreshing, and inspiring work of nature may be decaying because of careless pollution is alarming to our citizens; it gives them one more reason to believe that the environment is closing in on us. That we do not have all the facts as to the degree and rate of degradation is no answer. If we wait until all the facts are in, we may have irreversible destruction. The risk of harm is great, and the only benefit is convenience.

The third reason for our opposition is the resource mismanagement of it all. Somebody has said that pollution is matter in the wrong place. Most people don't think of sewage sludge and garbage as resources, even though they are. Unfortunately, they are also pollution if they are in the wrong place, as they frequently are. It seems to us that in our fight for a better environment we will have to convince ourselves that we cannot throw our wastes away. There is no place for them to go. If we cannot return them to nature's cycle, use, or back into the production process, they will continue to clutter up our landscape and seascape in ever-increasing quantities.

To focus on the total absurdity of it, consider that we are proposing to build a \$300 million sewage treatment facility to serve our northeast metropolitan area. The facility is in engineering design. Its purpose will be to accept the liquid wastes of the community; to separate the dirty part from the clean part; to put the clean part in New York Harbor. Then will we take the dirty part on barges 12 miles away and put it back in the water? Whatever the scientists or economists say about the precise effects, it has to be a preposterous system. If we consciously chose to do it this way, it would be more candid to skip the treatment plant altogether, run a big pipe 12 miles out to sea, and save a couple of hundred million dollars for more constructive purposes.

More than a year ago, New Jersey's Governor William Cahill publicly took a stand against the continuance of ocean dumping of wastes. He further urged that until the phase-out is complete, all wastes be disposed of at least 100 miles from our coast. That remains our position.

We consider it one of our top priorities to protect our State's marine environment. It was for this reason that our political processes at the urging of the

State administration, were able to produce an act last year giving the State control over the use of coastal wetlands. For the same reason, the State has taken a hard line on the retention of its ownership of riparian lands. These two steps have been taken so that our coastline is not developed wall to wall. The State has also taken a very hard line in enforcing the water pollution statutes against the operators of inadequate treatment plants whose effluents find their way, sooner or later, into our bays, estuaries, and ocean water. In fact, one of the ironies of the situation is that a considerable amount of the toxic materials now being barged to the ocean, are going there because we have obtained court injunctions against their continued deposition in our streams. The enforcement program will continue. It will include the 39 waste treatment plants along our shore whose effluent goes into the ocean. Current regional master plans already adopted indicate that within three to five years these plants, with a total capacity of about 20 mgd will no longer pump sludge into the ocean, but will rely on land disposal methods. Administrative action has already been taken against these facilities. Partly as a result of the 1969 Clean Water Bond Issue, we expect a massive construction program of regional waste treatment facilities in the first half of this decade. We don't want this enormously expensive and difficult undertaking to be frustrated by wanton ocean dumping.

We recognize that this is not a long-term answer, and that it will substantially increase disposal costs. But we in New Jersey place a high priority on the protection of the resources of our coastline, and believe the added costs must be borne if we are to protect our coastal environment. Seven major sewage treatment plants in New Jersey now rely on barging to sea for final disposition of sludge. They are:

	Tons per year	Barge cost per year	Per ton
Camden.....	42,000	\$89,000	2.12
Passaic Valley sewerage commissioners.....	620,000	430,000	.70
Elizabeth joint meeting.....	120,000	78,000	.65
Linden-Roselle (Including Rahway Valley).....	53,000	46,000	.87
Middlesex County.....	350,000	278,000	.80
Bergen County.....	275,000	250,000	.91
Total.....	1,460,100	1,171,000	

Camden's per ton costs are noticeably higher than the other plants because of the greater distance its barges must travel to the dumping area. We estimate that for each additional mile a barge would have to travel it would add \$0.035 (three and a half cents) per thousand gallons transported. For a year, therefore, if Camden's barges were required to dump no less than 100 miles from shore, the added cost would be about \$28,000 per year, or an increase of barging expenses of about 33%. I might note here that Bridgeton, one New Jersey community which previously relied on ocean dumping of sludge, abandoned the practice in January. By utilizing sand drying beds for sludge treatment and sale of the treated sludge to land fills and three nurseries, it contemplates saving \$40,000 in barging expenses this year alone. We believe this cost is justified by protection of the coastal waters the additional distance will provide while we search for a long-term solution. All these plants have been notified that ocean dumping is not acceptable, and that their future plans must provide for land-based disposal.

What are the alternatives? Frankly, as usual, they are not very good either. At present, we are talking about incineration or land disposal. While incinerators can now be constructed that are very efficient, they will, nonetheless, add some load to an atmosphere that already has more than it can accommodate. Land disposal in our state is becoming increasingly infeasible because of the diminishing number of sites. The practice at its best now represents a kind of land pollution. At the moment, we consider incineration to be much less harmful than ocean dumping. Over the longer term, however, it seems to us an absolute necessity that the materials contained in these sludges be separated and either returned to the land, or to reuse by man. The sludges that come from our large sewage treatment plants could not be used as soil nutrients in their present form. They contain such a quantity and variety of industrial chemicals that they probably would kill everything in sight. I am sure that if the pressure

were great enough, technology would find means to achieve the necessary separations. There has been no real attempt in the past to do so because we could always build an incinerator and gasify the waste, or put it in the barge waiting at dockside. If these conveniences are made unavailable, we may have provided the lacking incentive to achieve reuse, instead of just giving testimony about it.

As to the steps that we think should be taken now: We believe that the Congress should enact legislation that would prohibit 5 years hence, the ocean dumping of wastes. We believe further, that in the interim the Environmental Protection Agency should have the authority through a permit system to regulate this practice. We think that insofar as is possible, and as soon as possible, wastes disposed of in the ocean for the five-year period should be taken at least 100 miles from our coastline. We are fully mindful that this practice carries perils of its own. We are inadequately informed as to effect this relocation would have on the more distant marine environment. However, we would, at least, have the benefit of the protection of distance from our shoreline and of the greater dilution provided by waters of considerably greater depth. We are not advocating deepsea dumping of wastes; we are simply suggesting that in the interim period it appears less hazardous than dumping the same wastes close to our shoreline.

Both Senators from New Jersey have introduced legislation along these lines. Generally, we think the approach is good, but would offer two caveats. It is not possible immediately upon the effective date of such legislation for all wastes to be taken 100 miles to sea. Because of the greater distance and the fewer days per year when weather will allow the trip to be made, a considerable expansion in the barge fleet would be needed. Rather than an outright immediate ban on the continental shelf, we feel this could best be regulated in the discretion of EPA. Second, if the legislation were to contain language prohibiting the entry into ocean waters of any waste whatever, it might be construed to prevent the use of the ocean as the receiving water of treated effluent from coastal sewage works. While ultimately it is our hope that this water, at least to some extent, can be recharged to the ground or otherwise made available for reuse, the technology to do this is not immediately at hand. We have ordered all such treatment plants to upgrade to regional facilities providing a high degree of secondary treatment. At this point in time it is our belief that it is preferable to put the treated waste containing small amounts of organic matter into the ocean, rather than to put them into the bays and estuaries where their impact would be greater.

We believe that Congress is the appropriate agency to deal with this problem, partly because some of the waters involved are beyond the jurisdiction of the states, and partly because several states are involved. If suitable legislation is not enacted, however, we are prepared to take whatever steps prove to be available to us. We are now actively considering legislation that would give the State Department or Environmental Protection the right to regulate the loading of vessels with wastes destined to go into the ocean. This would be an incomplete remedy, but better than none. Our Attorney General is also considering the question of whether we have standing to seek injunctive relief in those cases where we believe dumping practices could be changed so as to lessen environmental harm. Further, we have already informed all those engaged in the design and construction of new and upgraded regional facilities that we will not approve this construction if it provides for the ocean disposal of sludge. This means that as construction proceeds, this practice will gradually be phased out in our State.

To solve the whole problem, however, including assurance that other states will ultimately discontinue ocean dumping, we feel it imperative that Congress act, and act now.

(Subsequent to the hearing, the following exchange of correspondence took place:)

APRIL 13, 1971.

Mr. RICHARD J. SULLIVAN,
Commissioner, New Jersey Department of Environmental Protection,
Trenton, N.J.

DEAR MR. SULLIVAN: On behalf of the Subcommittee on Air and Water Pollution, I wish to thank you for your useful contribution to our hearing on ocean dumping at Rehoboth Beach, Delaware.

In order to complete the hearing record, certain additional information would be helpful to clarify points made during testimony. Would you kindly supply us with written replies to the questions listed below at your earliest convenience? Thank you for your cooperation.

Sincerely,

EDMUND S. MUSKIE, U.S. Senator,
Chairman, Subcommittee on Air and Pollution.

Enclosure.

Question 1. During the hearings, Dr. Erb cited you as saying that "ocean outfall pipelines are the best solution for Cape May County shore communities disposal needs." He went on to say "This could clean up the bays while at the same time adding valuable nutrients to the oceans in a non-polluting manner." In your own testimony, you stated "The sludges that come from our large sewage treatment plants could not be used as soil nutrients in their present form. They contain such a quantity and variety of industrial chemicals that they probably would kill everything in sight." In view of the ability of marine organisms to concentrate toxic substances from diluted levels in sea water, how do you propose to control the level of such toxic substances in the outfalls?

Question 2. In line with question 1, what is the potential for undesirable effects of eutrophication resulting from the dumping of nutrients by outfall pipes?

Question 3. Some biologists have suggested that the discharge of freshwater into the oceans, as a solvent for sewage, has an adverse effect by diluting the salinity of the seawater in the dumping or outfall region. Could you comment on this?

STATE OF NEW JERSEY,
DEPARTMENT OF ENVIRONMENTAL PROTECTION,
Trenton, April 21, 1971.

HON. EDMUND S. MUSKIE,
U.S. Senate,
Chairman, Subcommittee on Air and Water Pollution,
Washington, D.C.

DEAR SENATOR MUSKIE: This is in reply to your letter of 13 April 1971 asking me to respond to three questions.

With respect to all three, I must make the following observation. The question is not whether or not we will dispose of effluent in the ocean. The question is will we dispose of effluent in the ocean, or in the bays, or other backwaters? Whatever problem might be contemplated on putting effluent into the ocean, whether it be salinity reduction, excessive nutrition, or whatever, would be many times more serious if shallow bays with little flushing action are used as receiving waters.

In any case, what we advocate and require are sewerage facilities providing a high degree of secondary treatment with the treated effluent entering the ocean. By oceanographic tests we have determined the most appropriate locations for these outfalls. This is not a new practice. We now have thirty-nine municipal treatment plants putting their treated effluent into the ocean on our northern shore. The problem is that most of them provide inadequate treatment and must be replaced by regional facilities with high treatment.

In the judgment of our technical people, the relatively small amounts of nutrients and other organic matter remaining after treatment can easily be absorbed by the marine system without harmful effect.

The sludges to which I referred in my testimony are those now being dumped off Sandy Hook. These are the materials that are left over after treatment in our large metropolitan sewerage plants. These facilities handle vast quantities of a wide variety of industrial materials. The sludges contain heavy metals and other contaminants. The outfall lines we propose for use along our shore are, and will be associated with plants processing domestic sewage. Neither the effluent nor the sludge will contain the toxic materials because wet industries will not use these systems.

Very truly yours,

RICHARD J. SULLIVAN,
Commissioner.

Senator Boggs. Thank you, Commissioner.

Gentlemen, before we proceed to the questions. I notice that Representative Harry Derrickson is here. He made the trip to the sludge dump site with Dr. MacDonald of the Council on Environmental Quality. I wonder if you care to give us your observations from that trip, Representative Derrickson?

Representative DERRICKSON. Thank you, Senator.

The observations that I can make here I think have already been drawn out in the testimony, but I would point out to you the need for speed in resolving this problem because this is hardly out of sight of the building that you are in and it may well be that they are out there dumping sludge this morning, and I think it needs to be resolved.

Senator Boggs. Thank you, sir.

Now, Senator Thomas Hickman. Like Representative Derrickson, Senator Hickman is a member of the Delaware General Assembly. We are honored that you are here today.

Do you have any comment you wish to make, Senator?

Senator HICKMAN. Senator, I wish to reiterate our stand that Mr. Heller so ably presented. I think we need immediate—as quick as possible policing, what we are doing now, and, secondly, that we do need to move to the 100-mile limit with the ultimate aim of stopping all dumping in the ocean. We think we have taken maybe a small step toward solving this with our recycling plant in Delaware which we are going ahead with. We heard Senator Muskie state that this be developed at the national level because we think this might be the ultimate solution to stop ocean dumping.

Thank you.

Senator Boggs. Thank you.

We were also delighted that Lt. Governor Bookhammer was here. I understand that he had to leave. But we appreciate his visit.

Senator Beall, do you have any questions or comments at this time?

Senator BEALL. I hesitate to ask the question because I don't want to start the kind of discussion that may result but it appears to me that there is some degree of disagreement on the panel that just testified with respect to the wisdom of dumping sludge in the oceans. I gather some people are recommending that we move in the direction not of cutting off altogether but of trying to find, and I gather this from what Mr. Coulter said, some good from using certain sections of the ocean for dumping of sludge, whereas, others have testified that we should move in the direction of eliminating it altogether. I don't know how to ask the question without getting the panel into an argument with each other, but what I would like, for my own edification, if they would discuss it just briefly whether or not—

Mr. SULLIVAN. Your question, Senator, is which one of us is right.

Senator BEALL (continuing). Yes, and the question is we have to dispose of sludge somewhere and can we dispose of it in the ocean if it is properly controlled.

Senator Boggs. Secretary Heller.

Mr. HELLER. I think one has to make a differentiation, Senator, of the nature of the materials to be disposed of. The point that we tried to make today was that the nature of the sewage sludges that are being discharged into the ocean today on the east coast, and probably on the west coast, are materials that represent not only the results

of waste from ordinary municipal or residential use but also from many, many industries, and herein really lies the crux of the matter because the sludge acts as a concentrate of the highly toxic materials that are in the raw sewage to begin with. I am talking about the heavy metals and pesticides. I think it has been pretty well demonstrated that if you discharge highly toxic material into a biological system, such as the ocean, with the special talent to concentrate these materials and then find that the end prize, so to speak, the food change, I think the objective ought to be to ban the dumping of these materials into the ocean. Frankly, I do not think we have any other choice but to examine it and accept that as our target.

Secondly, the discharge of industrial waste that contain heavy metals fall in the exact same category because the biological system there is going to react in the same way.

We cannot afford to discharge toxic materials into our streams for the reason the streams can't handle them on a dilution basis, and we certainly can't handle them in the ocean. It seems to me that the Congress in its deliberations ought to separate out those materials that are being discharged today that are definitely toxic in their nature and set the priority for the elimination of these materials. And then perhaps we can examine the ocean dumping of other materials that perhaps may not be as toxic, that might in some way be a candidate for proper management.

Senator Boggs. Mr. Coulter?

Mr. COULTER. Mr. Chairman, Senator Beall, I think there is a basic disagreement but perhaps there is more agreement than shows here. I think the three of us are really asking for an application of the assessment of science to water pollution control. As the three of us have pointed out all waste material has to go somewhere, our choices are air, land or water.

My plea is that we don't arbitrarily say that the ocean is sanctified in such a way that we have to dispose of some material in the air or on the land which would cause difficulties, and perhaps more difficulties, and certainly that we do not rule out the very real possibility that some materials going into the ocean will enhance the values of the ocean just as some materials go into the land would.

As a matter of fact, in the Maryland studies, we found that much of our Continental Shelf, off Maryland, is underfertilized at the present time, to the fishery values that we would like to enhance; that the exchange of water off that shelf is something like 2 to 2½ years and that, for a period of time, the build up of fertilizer materials would be beneficial; after a period of time, under close monitoring, if the waters tend to become overfertilized, then the thought would be that the dumping would be moved further out to sea.

But essentially my plea is that we get a sense of science in this and that we do not arbitrarily rule out any of the possibilities that our best scientific minds can give us for handling this very important sludge disposal part of pollution control.

Senator Boggs. Commissioner Sullivan.

Mr. SULLIVAN. A brief comment from another point of view; I am concerned, being a professional bureaucrat and supposed to operate a regulatory agency, about the posture taken by Government in solving pollution problems. It seems to me that unless we have, in our legislation, clear black and white, a 5-year deadline on the use of the oceans

for dumping purposes, then we will not provide the necessary incentive to those who are now using this convenience, to spend money to find other ways of doing it, and I think my concern about Jim Coulter's presentation is that while there is scientific validity to it, if it leaves the impression that, well, for some things maybe, for other things maybe not, we are going to lose the pressure point that we need to change this whole system around.

Senator Boggs. Senator Buckley.

Senator BUCKLEY. I would just like to ask Mr. Coulter one question, if I may.

In your calculation as to the dilution factor of 1 in 10,000 doesn't that still leave us with a problem of biological concentration?

Mr. COULTER. Senator, that was taken into consideration and we used the standards which have been adopted for biological concentrations for the shellfish and also for bathing waters.

Senator BUCKLEY. I would like to ask Mr. Heller whether crustaceans change by concentrations of toxic metals as the shellfish?

Mr. HELLER. I don't believe so, Senator.

Senator BUCKLEY. I am glad to hear that because I am going to have crabcake for lunch. [Laughter.]

Senator Boggs. Are there any other questions?

If not, gentlemen, the committee wishes to thank each of you for the work you have given to these excellent presentations. I assure you that all the members of the committee, whether they are here or not, will benefit by your testimony as the committee considers this legislation.

The Congress has to write new water quality legislation this year. So I can assure you that the Senate and the House will move ahead on these matters. Your contributions have been very helpful.

I am going to ask the staff of the committee to provide several questions for Secretary Heller, Secretary Coulter, and Commissioner Sullivan. We would appreciate it if you would answer them for the record.

Thank you very much.

Would the mayors come forward at this time. The mayors include Mayor Johnson of Rehoboth, our host; Mayor Stango of Lewes; Mayor Masciarella of Wildwood, N.J.; and Mayor Harry W. Kelley, Jr., of Ocean City, Md.

While the mayors are being seated, I would like to have the unanimous consent of the committee to include in the hearing record a copy of a resolution adopted, unanimously, by the commissioners of the city of Rehoboth Beach on December 11, 1970. It deals with this problem of ocean dumping. Without objection it will be made part of the record.

(Resolution follows:)

Whereas, it has recently been discovered that an area approximately 12 miles in diameter, located in the Atlantic Ocean and situated between the Southeasterly edge of McCrie Shoal and the Northeasterly side of the Delaware Bay-Cape May Open Traffic Lane, approximately 6 miles East-Northeastwardly from Rehoboth Beach, Delaware, has been closed and condemned for shellfishing by the Food and Drug Administration, a branch of the United States Department of Health, Education and Welfare; and

Whereas, the action taken by the Food and Drug Administration, a branch of the United States Department of Health, Education and Welfare, resulted from the hazardous conditions which have grown to exist in the foregoing geographical area because of the fact that the United States Army Corps of Engineers, ap-

proximately 10 years ago, approved this same area as a dumping site for sewage sludge from Philadelphia, Pennsylvania, Camden, New Jersey and other cities bordering along both shores of the Delaware River; and

Whereas, it has been graphically illustrated over the past several years that pollution of the ocean floor resulting from unbridled use of our oceans for the purposes of oil drilling and dumping grounds may culminate in disaster for coastal areas adjacent to such operations; and

Whereas, The City of Rehoboth Beach, Delaware enjoys the reputation of being the Nation's Capital Ocean Resort and caters to thousands of summer vacationers without whose patronage this community could not exist, and

Whereas, the economic stability of The City of Rehoboth Beach and other municipalities adjacent and contiguous thereto is greatly aided by the existence of the shellfish industry and fishing industry, which industries provide employment for countless numbers of local residents; and

Whereas, the existence of the unfortunate situation hereinabove described has placed in serious jeopardy the economic stability of the City of Rehoboth Beach both as a vacation resort and as a shellfishery and fishing center.

Now therefore be it resolved by the Board of Commissioners of The City of Rehoboth Beach that the Attorney General of the State of Delaware be memorialized to institute immediate legal action seeking injunctive relief against those agencies of the Federal Government which have permitted the dumping of sewage sludge from the City of Philadelphia, the City of Camden and numerous other cities along both shores of the Delaware River on the basis that the pollution created by the dumping of such sewage sludge, has, is and will in the future cause irreparable damage to the State of Delaware and each and every seaboard community of the State of Delaware.

Be it further resolved that a copy of this resolution be spread upon the minutes of a meeting of the Board of Commissioners of The City of Rehoboth Beach, and that copies thereof, be forwarded to the following individuals: Honorable John J. Williams, Honorable J. Caleb Boggs, Honorable William V. Roth, Jr., Governor Russell W. Peterson, Attorney General David P. Buckson, Attorney General W. Laird Stabler, Jr., Army Corps of Engineers. Secretary of Interior Rogers Morton.

LESTER F. JOHNSON,
Mayor.

JAY D. WINGATE,
Vice President.

M. R. SINGLER,
Secretary.

(And four others.)

Mayor Johnson, as our host, would you proceed with your statement and comments.

STATEMENT OF HON. LESTER F. JOHNSON, MAYOR, REHOBOTH BEACH

Mayor JOHNSON. Senator Boggs, Senator Beall, and Senator Buckley.

We, the mayors of the coastal resorts of Maryland, Delaware, and New Jersey, representing our respective communities, wish to thank you for conducting this hearing in Rehoboth and extend to each one of you our most sincere welcome.

We believe that your presence here signifies that you have a real concern for the welfare of our resort areas and for the economic well-being of our citizens.

I want to make one statement that hasn't been made and I am surprised that it hasn't been made. At the present time our ocean bathing areas are not polluted. You might think that we are going to have pollution in here but they are not polluted. But there is every evidence that pollution of our shore areas will occur as has happened in some other places, if we continue with our ocean dumping as is.

Others will testify that the shellfish and fishing industry has been adversely affected by ocean dumping from large metropolitan areas north of us. The dumping ground is dead area and continues to spread toward our shores as dumping continues. The ocean will not continue to receive and hold in one spot the continuous dumping of sewage, arsenic compounds and other harmful pollutants.

After a storm the beaches are eroded and debris is washed ashore from great distances. Action of the waves and current move tons of sand along the bottom of the ocean. This is a condition that enables Rehoboth beaches to build up by means of jetties that trap the sand as it moves. The bathing beach today was the ocean bottom south of Rehoboth yesterday. Place an object in the ocean a few miles from shore and it will usually be cast upon the shore somewhere.

The economy of our coastal area depends upon tourist trade and the maintenance of wholesome summer resorts. How utterly foolish it is to take waste and sewage from urban areas and dump it in the ocean only a few miles from ocean resorts—kill the marine life and chance the pollution of our shores. It has happened in Hawaii. It can happen here.

Sirs, we respectfully request that proper legislation be enacted that will forbid ocean dumping at any time. We owe that much to our children and grandchildren. It may not affect us—it certainly will affect them.

I have a few slides that I would like to show to substantiate the fact that we have something worth protecting. The slides are pictures of the area from Indian River Inlet to and includes Lewes.

(Slides shown at this point.)

There is a picture of our Rehoboth Beach during the season. You see no pollution there. That is a beautiful beach, it is well worth protecting and safeguarding against pollution. We think it is rather foolish for municipalities north of us, or anywhere, to dump their sewage and waste materials in our front yard.

There is a picture of the Indian River Inlet that shows a fishing boat coming in from unpolluted waters. There is another picture of the Indian River Inlet.

This is an aerial view of Rehoboth and this is the view launching area at Lewes. This is a picture of Dewey Beach, isn't it?—Dewey Beach. This is a picture of the coastline looking north from Indian River Inlet, this beautiful stretch of beach. This is an aerial view of Rehoboth; and this is a picture of the surfing area at the Inlet, just north of the Inlet, and on this side of it is the fishing area.

This is the marina at the Henlopen Acres; and there is another picture that shows the well kept beach. This is the ferry, the Lewes-Cape May ferry. In this you are looking down on Rehoboth Avenue from the air. Another picture of Rehoboth Beach, Dewey Beach, and this is a picture of the Henlopen Area; there is the inlet, and this is a picture down at Fenwick Island.

Now, here is what can happen: 2 years ago last November an oil barge came ashore at the center of our beach area—there is the result of it. We thought we were out of business for a while but we cleaned that area up. It was something we could get hold of and we could take care of it, but that dead spot of the dumping area of approximately 120 square miles in area is spreading and coming

toward our shores if the ocean dumping continues. And although we may not live to see our beaches polluted, if ocean dumping is continued I am certain that our children and grandchildren will not enjoy the beaches as we enjoy them.

Therefore, I would like to introduce, Mr. Chairman, the mayors here with me.

Senator Boggs. Does that conclude the pictures?

Mayor JOHNSON. That is the end of the pictures.

Senator Boggs. They were very good pictures, Mayor.

Mayor JOHNSON. That is our own beach area but I know that New Jersey has just as fine beaches, and so does Maryland. There are only certain sections of our country where there might be any pollution and that is due to the dumping of sewage into the ocean.

To my right is Mr. Ralph Graves who is head of the government at Bethany; to my left is the mayor of Lewes, and the mayor of Wildwood, I believe he has been asked to make a statement, Mayor Masciarella. The next is Mayor Murphy of Henlopen Acres, a newly incorporated area, and then Mayor Kelley from Ocean City. If Mayor Kelley or Mayor Masciarella would like to speak I would be glad to give part of my time.

I am very pleased, Mr. Chairman, that you presented Senator Muskie with the ashtray.

Senator Boggs. He was happy to have it.

Mayor JOHNSON. Each one of you has an ashtray in front of you, we hope you will take it to remind you of your visit to Rehoboth, and as you dump your cigar ashes on the name of Rehoboth, please get active and don't pollute it. [Laughter.]

Senator Boggs. Very good, Mayor. Thank you very much. Mayor Masciarella, we would be glad to hear from you at this time.

STATEMENT OF HON. CHARLES M. MASCIARELLA, MAYOR, WILDWOOD, N.J.

Mayor MASCIARELLA. Gentlemen of the subcommittee, may I add my word of welcome to that of many dignitaries from the communities of this area for your presence here today. We, of the Wildwoods, are most grateful and encouraged by your on-the-spot review of our serious ocean pollution problem. We trust that your visit here will be helpful in determining the need for strong national legislation for all U.S. coastal areas, with particular application to the Delaware Bay region.

We believe our own dire circumstances may serve as a warning to other areas to take heed, and hopefully action, before concentrated ocean dumping destroys the ecological balance of such a great and common resource as the ocean near to land.

Ocean dumping—a growing problem. Ocean dumping has become a serious national problem, particularly in recent years. It has grown much more rapidly in the last 3 years, and some, including the President's Council on Environmental Quality, believe that if it continues very long at its present rate it will be costly and difficult to shift to land-based disposal at some future date. This is clearly the time for a conscious national effort to halt uncontrolled ocean dumping.

The types of ocean dumping vary, and offer different degrees of danger to health, economy, and nature's beauty. They include: No. 1, sewage sludge; No. 2, industrial wastes—some toxic; No. 3, dredging

spoils; No. 4, solid wastes; No. 5, explosives and chemical warfare agents; and No. 6, radioactive materials.

The last two types have been phased out due to the public outcry of the late sixties. But, according to the council's report, 10 of these type dump sites exist a distance off the Jersey shore, or one-sixth the total number of such sites located in all the coastal waters of the United States.

THE PRESENT DANGER TO OUR SHORES

The dump sites of greatest concern to us now are those located a short distance off our coast. Continued dumping of sewage sludge and industrial wastes have polluted the ocean only $5\frac{1}{2}$ miles from our shoreline to such an extent that on May 19, 1970, an area 12 miles in diameter was found to be "polluted and the shellfish contaminated." Fishermen were warned not to harvest in this area by the U.S. Department of Health, Education, and Welfare, the Public Health Service, and the Food and Drug Administration. Imagine, gentlemen, a contaminated area approximately 150 square miles of ocean. This area is about equal in size to the famous dead sea off New York harbor and, I might add, New Jersey's north coast.

Gentlemen, there are only four sewage sludge ocean dumps in U.S. coastal waters, and three of them are off the New Jersey coast, with one of them $5\frac{1}{2}$ miles from our Cape May shore. Some of this sewage is treated, such as Philadelphia, 90 percent; Camden, 25 percent, and some not at all—Bridgeton, N.J. Combined they dumped 82,556,000 gallons in 1970. Undoubtedly, somebody heard of the coming of the subcommittee as the city of Bridgeton recently announced its termination of ocean dumping of their sewage sludge. Sewage sludge is harmful in many ways, but mostly because it removes oxygen from the ocean and tends to perpetuate itself, thereby introducing a semi-permanent status, continually killing sea life. Unfortunately, sewage sludge dumping in this shallow water area is the worse possible place since it is the breeding ground for large numbers and types of fish who go out to sea in many directions.

Gentleman, why should sewage sludge continue to be dumped into our area by major urban cities, such as Philadelphia, when it is rarely permitted anywhere else. Many have found ways to recycle this kind of waste, and convert it to meaningful uses due to its high nutrient value. It may also be helpful for Pennsylvania to use it to reclaim its many stretches of strip mining desolation.

Cape May County and Delaware State resorts share another unique situation. We appear to be the only area in the country which has two industrial dump sites positioned off our coasts, both near to land. To our knowledge, no other area can make this unfortunate claim.

This intense dumping of sewage sludge and industrial wastes—both toxic and nontoxic—over a period of years has substantially harmed and destroyed adjacent sea life. Our fishing industry has been severely damaged in both the harvesting and processing fields. It also presents an unnecessary hazard to the public health, even though strict inspections are made of the catches. I am sure the many members of the fishing industry here today will more adequately inform you of this pollution impact on valuable sea resources. Suffice it to say that our \$40 million fishing industry, an important prop to our area economy, is threatened with ruin.

THE 3-MILE LIMIT OBSTACLE

The ocean dumping problem is compounded by the principle of the 3-mile limit of marine jurisdiction, and the lack of supervision of the actual dumping. This must be one of the prime objectives of the subcommittee here this morning. We have often heard the end response to our complaints about ocean dumping, that the dumping occurs beyond the 3-mile limit of our continental shores, and is outside the jurisdiction of State and Federal law, and a part of international law. Sure this law, which was born during the early growth period of America, has little application in the 1970's, when our problems are more intense and complicated.

We must adopt to the present, where our ecological survival is involved, and adopt new legislation controlling at least, and preferably phasing out this obnoxious form of disposal. The precedent seems well established in other departments of the U.S. Government for controlling the problem at its point of origin, which, in this case, is our shipping docks. Under the Environmental Protection Agency permits for ocean dumping could be applied for, and in those rare instances where they were granted, they would only be for a distance of at least 100 miles at sea.

The other lax part of our present system is that supervision of present dumping is practically nonexistent. This means that ships loaded with all forms of wastes could, if they chose, and no ships were in the area, dump their cargo during the trip from the dock to the shallow water dump sites. There is little doubt in the minds of the many fishermen that are here today that this is done with regularity. It would be necessary for the Coast Guard either to escort the barges en route, or observe the disposal at the dump site to avoid this condition. A trip across the last 20-mile section of the Delaware River, and the first 20 miles of the ocean, will convince even the most rabid skeptic that this great body of water has been abused, that it is questionable whether it can be returned to its original state.

The end of ocean dumping is vital to the Greater Wildwoods, Cape May County, and to our sister State of Delaware. The principal industries in the Greater Wildwoods and Cape May County are shellfishing, \$40 million worth; and the motel-hotel tourist industry, which represents hundreds of millions of dollars. Our entire economy and the means of livelihood for our people, could be wiped out by this growth in ocean pollution. The truth is that our shellfishing industry is hurting badly now. With 150 square miles of prime harvesting grounds off limits, they are compelled to seek less productive sources and locations at a greater cost in time and effort. Nationally, 20 percent of the fishing grounds are off limits. In San Francisco Bay, where between 100,000 and 300,000 pounds of clams were once harvested, there is hardly any brought in today. We believe our situation is going toward that of San Francisco.

Interestingly enough, the south Jersey coast now has a higher number of ocean dumps than San Francisco. According to our estimates, taken from the publication "Ocean Dumping, a National Policy," there are 14 dump sites for 80 miles of New Jersey coastline, or one each 6 miles.

THE BEACHES ARE MOST VALUABLE

The main thought I would like to convey to the subcommittee is that our prime assets, the beaches, are now in serious jeopardy. This is no idle speculation, gentlemen. If the public once got the impression that the Jersey and Delaware beaches were unsafe for bathing, we would face instant bankruptcy. And it would be a long time coming back, if ever. We cannot avoid this harsh reality since some beaches have already been closed because of the high coliform bacteria count. This has happened as close to us as Long Island, which, by the way, borders on the similar dead sea area of New York Harbor. What this could do to our resort industry is horrible even to think about. We would be ruined. The FDA found that ocean bottom sediments up to 6 miles from the New York bight sludge dump contained bacteria counts that exceeded permissible health standards. Gentlemen, the fringe of the Delaware Bay polluted area is only $5\frac{1}{2}$ miles from the nearest Cape May shore.

There is evidence of industrial toxic wastes being dumped in the Cape May-Delaware sites. There have been two examples of toxic waste dumping attempts in the last month:

Chemical oil sludge was approved by Pennsylvania State authorities for dumping off this area, but halted by injunction and will now be deposited far at sea.

Rohm & Hass, a Pennsylvania concern, attempted last week to dump 70 tons of arsenic compound. They have halted this activity temporarily, pending a meeting last Friday in Washington with the Environmental Protection Agency.

This is only a fraction of the deadly wastes being dumped in our off-shore area. I would like to submit the following data to the subcommittee which was compiled by the Corps of Engineers. Philadelphia District, in November 1970. I quote, "Enclosed for your information is a list of companies, their disposed waste, and the quantity of waste dumped off the coast of south Jersey this year."

CHEMICAL AND INDUSTRIAL WASTES

Rohm & Haas, arsenic compound, 690 tons. Note, this is 10 times the amount this company held up last week.

Gulf Oil, industrial waste water, 13,000 pounds; Rohm & Haas, arsenic solution, 2,500,000 gallons; Rollins & Parle, acid wastes, 4,453,368 gallons; Du Pont Chambers Works, industrial sludge, 1,689,512 gallons; and Du Pont Edgemotor, acid waste, 65,584,380 gallons.

And Philadelphia, Camden, and Bridgeton are responsible for 82,566,380 gallons of sewage sludge.

Gentleman, there was a public uproar over the disclosure of the Rohm & Haas and Pennsylvania oil sludge dumping efforts. This new information represents a more serious problem than we can envision. We are poisoning the sea.

In conclusion, gentlemen, I would like to believe that these conditions warrant the careful consideration of the subcommittee and action at the earliest opportunity. We fear for our health, our homes, and our economy.

Cape May County has far more to lose than civic pride. Our hundreds-of-million-dollar resort industry, and multimillion-dollar fish-

ing industry are at stake in this ocean dumping discussion. Our economy simply will not function without these major segments of our business. We cannot afford to overlook further pollution of the ocean and sit idly by as our whole economy disintegrates before our very eyes.

It is not for us alone that we ask your assistance. These lovely shores are the assets of the millions of people who annually come here to take respite from their burdens and relax in nature's areas. If we are to protect them and maintain their natural beauty for future generations, we must have new Federal and State laws designed to protect the environment, and both Federal and State administrations committed to putting them into action.

Gentlemen, one of the largest industries in the world is the seashore and resort business and we have much to lose for millions and millions of people for the pleasure and health of them all.

I would like to request that the subcommittee do what they can in the very near future, as quickly as possible, to overcome this problem we have and I also realize the fact that there is a time period and a transition of ocean dumping through other means, incineration or whatever, that the chemists or the scientists can come up with.

I certainly want to thank the subcommittee for the Greater Wildwoods and Cape May County for giving me the opportunity to speak here today. I certainly appreciate it.

Senator Boggs. Thank you, Mayor. That was a fine statement. We will put each of the statements that we have in the record.

Mayor JOHNSON. I was going to make that request, Mr. Chairman.

Senator Boggs. They will be in the record. But you go ahead because we want to hear individual comments from each of the mayors.

Mayor GRAVES. I am Mayor Ralph Graves.

Senator Boggs. Mayor, we're glad to have you here.

STATEMENT OF RALPH K. GRAVES, PRESIDENT, BOARD OF COMMISSIONERS OF BETHANY BEACH

Mayor GRAVES. Senator Boggs and other distinguished members of the committee, it gives me a great deal of pleasure on behalf of the residents of Bethany Beach to appear before the subcommittee hearing.

Mr. Chairman, members of the Senate Subcommittee on Air and Water Pollution, I thank you very much for the invitation to appear here today. It is with a deep sense of pride and humility that I appear before this most important committee of the U.S. Senate. It is also an honor to be privileged to add my small voice to such a vast and important subject.

If the future health and well-being of our Nation is to be preserved for ourselves and for the generations that are yet unborn, it will be, to a large degree, accomplished through the intelligent guidance and the untiring efforts of this committee. Your mission is an awesome one.

Gentlemen, I think that my contribution to this hearing, if I can make one indeed, is to tell you just how important it is to my community that we find a way to and successfully put an end to ocean dumping. We are not experts on ecology but we do know what is happening to our environment and, frankly speaking, gentlemen, we don't like it. and we are willing to roll up our sleeves and do something about it.

The town of Bethany Beach is a very small ocean resort community, one and a quarter square miles of geography. Perhaps it so small that

many people have never heard of it. However, it is our town and our homes are there and we feel that our children and ourselves should be protected from those who would indiscriminately dump waste into the rivers and bays that empty into the ocean, as well as those who would dump directly into the ocean, and make it a huge sewer and ruin our town and its future.

Bethany Beach is an incorporated town with approximately 800 homes, most of which are occupied in the late spring, summer, and early fall. In addition, we have three motels and a small number of apartment units. In other words, while it is a little over 60 years old, it is still a small family summer resort with only a few supporting commercial activities and with only very modest fiscal resources. We have only about 300 year-around residents and we reach an estimated 6,500 to 7,000 people in the town on a summer weekend.

As you can readily see the entire community exists by virtue of the fact that it has been a healthful ocean resort area. It has been developed for families—a place where parents can bring their children for vacations. We are proud that we have been able to keep Bethany Beach a safe and healthful beach resort. The families come from the Washington and Baltimore metropolitan areas, from Pennsylvania, New York, Massachusetts, Virginia, Ohio, Indiana, and on and on. This is our mission; this is our entire economy; this is our very being. Now it is threatened because of unthinking, uncaring indiscriminate dumping of waste.

As I said before, our resources are small, but what we can do ourselves to protect our environment, we are trying to do. We are not in the very middle of planning a sanitary sewage disposal system from the town which will cost the people of Bethany Beach about \$2,100,000, and hopefully the Federal Government and State of Delaware an estimated \$2 million through grants. This is a considerable sum of money for an extremely small summer ocean resort town to spend on the protection of its ecology. However, the taxpayers of Bethany Beach at a referendum voted overwhelmingly—4 to 1—to install this sewer system in order to help improve their environment. Hopefully, the actual construction of the sewer system will begin the latter part of the summer of 1971. But all of this, as well as the investment in land, residences, road, streets, utilities, et cetera, will be of little avail if something isn't accomplished, and very soon, to stop the dumping of refuse in Delaware Bay and the Atlantic Ocean. Not only is the ecology at stake here, but the economy of the area as well. Yes, even the very existence of the Atlantic coast resort areas which our town, Bethany Beach, is a small but to us, an extremely important part, is threatened by this dumping of waste.

Gentlemen, we implore you to use your very best efforts and resources at the national level to stop further pollution of the Atlantic Ocean. In stopping ocean dumping you will be stopping the Atlantic from becoming a huge sewer and you will be helping the coastal communities to maintain safe and healthful resort areas for our children and for their children that follow.

Mr. Chairman, again I wish to thank you for the opportunity of appearing here today and I express the thoughts, the feelings and the hopes of all whom I represent at this hearing when I say we wish you every success in this most worthy cause and your undertaking with it.

Thank you.

Senator Boggs. Thank you, Mayor, for a fine statement.

Mayor Stango of Lewes.

**STATEMENT OF HON. ALFRED A. STANGO, MAYOR,
CITY OF LEWES, DEL.**

Mayor STANGO. Senator Boggs, Senator Beall, and Senator Buckley.

We want to thank you for taking time out from your busy schedule to come to Rehoboth to listen to our problems.

I would like to go on record as being opposed to ocean dumping in every respect. Further, we should do everything within our power to eliminate every conceivable type of dumping; chemical, sludge, waste, gases, etc. Immediate action should be taken to insure that our sea life is not destroyed.

To annihilate our sea life would drastically affect the economy of the city of Lewes and vicinity. Lewes is, without question, a fisherman's haven and accordingly, dependent largely upon sea life. A State operated boat launching ramp located in Lewes, has grown, during the past few years, to be known as the heaviest used launching ramp in the State. The Game and Fish Commission has recognized its heavy usage and is presently contemplating expansion of the facility. It's obvious to everyone, the fishing industry, particularly in this area, is on the incline. To deter this economic boost would be disastrous for the entire area.

As Senator Boggs knows the city of Lewes better than I do—the influx of people that we have and the influx of fishermen that come, we would like to stop this ocean dumping to protect the sea life which would protect the economy of the city of Lewes and the vicinity.

Lewes, without question, is a fisherman's haven and, accordingly, dependent to a large degree upon the sea life. A State operated launching ramp located in Lewes is one of the heaviest in use in the State of Delaware and, therefore, the Game and Fish Commission has recognized its usage and is presently contemplating an expansion of the facility. It is obvious to everyone that the fishing industry, particularly in this area is on the incline. To stop this part of the economy would be disastrous for the entire area.

Accordingly, I respectfully request that the committee strongly oppose ocean dumping in every respect.

I would like to take this opportunity to thank Senator Buckley for his concern about ocean dumping, outfall dumping. I am also concerned about this.

Senator Boggs. Very good, Mr. Mayor. Thank you very much for your excellent statement.

Mayor Murphy, I am glad to see you.

**STATEMENT OF HON. J. EDWARD MURPHY, MAYOR, TOWN OF
HENLOPEN ACRES, N.J.**

Mayor MURPHY. Senator, it is a real pleasure to see you again.

It is with pleasure that I, as mayor, make the following statement in behalf of the citizens of the town of Henlopen Acres, Del.

Ours is a small and somewhat unique community—purely residential in nature with 143 homes. There is no commercial activity.

Many of our homeowners are retirees, people who located here where they could enjoy, in their late years, the beauty of nature. Where they could walk through wooded areas yet be near beaches that afforded them the opportunity to swim, sunbathe, fish, crab, and clam.

Homes in Henlopen Acres range in value between \$40,000 and \$200,000 representing a considerable investment.

Henlopen Acres at its eastern end fronts on 1,143 feet of clean gently sloping ocean beach which is used by residents and their guests.

The Lewes and Rehoboth Canal, a tidal waterway, forms our northern and northwestern boundaries.

We are naturally concerned about the dangers posed by offshore dumping and particularly by the presence of partially treated sewage in a dumping area just $7\frac{1}{2}$ miles from our beach front.

We certainly don't relish the thought that a severe offshore storm could conceivably deposit filth on our beach or the beaches of our neighboring communities.

We add our voice to those who today are asking that something be done—and done now—to curtail offshore dumping.

I guess Henlopen Acres is the closest neighbor to Rehoboth, we border on the northern part of Rehoboth, and I told Mayor Johnson yesterday that I am quite sure that everything that he said would be appropriate to our little section over here in Henlopen Acres. I certainly endorse everything that has been said by all of the mayors and join them in expressing appreciation that you care here.

Senator Boggs Thank you, Mayor Murphy.

Now, Mayor Kelley of Ocean City. We have your full statement, which will be made part of the record; you can read it or summarize it, whichever you wish. We are honored to have you here. I would like to catch some of those Marlin off Ocean City.

STATEMENT OF HON. HARRY W. KELLEY, JR., MAYOR, TOWN OF OCEAN CITY, MD.

Mayor KELLEY. Thank you, Senator Boggs.

Mr. Chairman, Senator Beall, Senator Buckley,

We wish first of all to thank you for offering us the opportunity to make this statement before this eminent committee on such an important issue.

In behalf of the town of Ocean City, Md., we would like to advise you that it is the stated policy of the governing body of our town that we are opposed to all indiscriminate dumping of untreated sludge, sewage, chemical, or other potentially harmful waste matter into the Atlantic Ocean. We feel that the poorly regulated and unsupervised dumping into the ocean of any substance that has not been treated to the extent of rendering said matter harmless, is a severe threat to the ecology, the health, and the economy of all areas within reach of the effects of said dumping.

However, we would like to emphasize that our main opposition to said dumping is directed at the fact that the matter dumped is not treated or is insufficiently treated to render it harmless, and further that apparently the dumping procedure is not closely supervised, if it is supervised at all, and that the testing of the matter so dumped is either inadequate or nonexistent.

We feel that the major question is not the complete prohibition of all dumping, but the absolute necessity of seeing that matter discharged and dumped into the ocean, or the tributaries leading to the ocean, is extensively treated, processed, and properly discharged in such a manner that its merging into the ocean is harmless to all living things whether in the ocean or on the bordering land.

We think that it is extremely important that a rational difference be made between the dumping or discharging of chemicals, sludges, or solid wastes and the disposal of extensively and properly treated waste water, harmless to marine life and man alike.

We feel that the major emphasis should be in the area of regulation to insure that any matter disposed of in the sea will not cause an adverse effect on the waters of the ocean or adjacent land area, and further that any such disposal shall be allowed only after proper and sufficient scientific study, and with continuing controls and supervision by qualified personnel.

I would like to add just a couple of statements; we are concerned in Ocean City, the reason we are here today. However, we do not as yet have the problem that our northern resorts have. We had the greatest fishing year that we have ever had in the history of the town, that was sport-wise.

Commercially, the fishermen tell me that the Russian trawlers out there are killing them in that respect.

But we are aware of this problem; our sanitary commission, our other officials are constantly on the alert looking for any algae, odors, or waste, whatever, that would come in on the beach.

I thank you for this opportunity to be here today and we certainly, all of us down here, are very appreciative that you gentlemen would take the time to come down here and hear our tale of woe.

Thank you.

Senator Boggs. Thank you, Mayor. I want to say that the committee is most appreciative of the fact that each and every one of you has taken time from your busy schedules to come here and present your views. It will be most helpful.

Senator Beall and Senator Buckley, do you have any questions to ask or any comments?

Senator BEALL. No, Mr. Chairman; I have no questions. I just appreciate the fact that the mayors have come here today and allowed us to have the benefit of their thinking because they are probably as close to the problem as anybody here. We always like to hear from those people who have to deal with it on a daily basis as we are better able to come up with the best and eventual solution.

Senator BUCKLEY. I, too, would like to express my appreciation. I think we can see what can happen in a resort area and I think we all have the responsibility to see that it doesn't happen here or anyplace else in the country.

Senator Boggs. Thank you, Senator Buckley.

Gentlemen, we thank you very, very much.

Before we break for lunch, we have a distinguished gentleman with us, the city commissioner of Wildwood, Mr. Wilbur J. Ostrander. He has to get away and he asked permission to come forward at this time to submit his statement for the record and make a few comments. We are glad that you came over and we appreciate your contribution, Commissioner Ostrander.

Mr. OSTRANDER. Thank you so very much, Senator Boggs.

I suspect, and I would like this to go on record, that directly, or indirectly, through an organization called SODA, or Stop Ocean Dumping Association, a very fine gentleman in your community by the name of Dave Hugg reached out and selected or arranged for you marvelous people to come and create this subhearing on ocean dumping.

We are terribly, terribly concerned and this is the reason that the Stop Ocean Dumping Association was originally formed, back in September 1970. We are delighted with the impact that this organization has created, not only from the standpoint of this particular subcommittee but we have had some very astute gentlemen in our area over the last few months, scientists and oceanographers, who very well can understand the problems that we are faced with, and I would like for the record, Mayor Aiken, of the city of Bridgeton, N.J., on his own initiative, decided that they would stop their dumping in the ocean, and there is a very cute quirk involved in that stopping. It cost the city of Bridgeton \$60,000 to \$80,000 a year to dump their materials. They have now found a way to reclaim the materials, believe it or not, and are making a profit on it.

Senator Boggs. Great.

Mr. OSTRANDER. And that gentleman should be eulogized to the end of the earth.

The city of Camden, I understand, is making arrangements to build the proper facilities so they will curtail their activities.

I am a little distressed, and believe me, there is a gentleman in this audience today, Mr. Baxter from the city of Philadelphia, who is a very marvelous person, but I have to take issue with his consideration; I think Mr. Baxter is just a little adamant and only primarily because perhaps of the problems that we are all faced with in our cities in the sense of finding the money to do the job. And I would suspect that Mr. Baxter, if he had the proper facilities and the proper money, it would be no problem for the city of Philadelphia to stop those things that they are doing to our oceans, and he does say that they are treating their materials 90 percent, but when we talk about the quantity we are probably wondering what that other 10 percent is doing to fish life.

And I might indicate to Mr. Baxter that when debris is dumped into the ocean in solid form that the poor little clam at the bottom of that heap cannot move out of the way, and is buried and cuts his life short at that time.

Senator Boggs. I might say at this point that when we come back after lunch, our first witness will be Mr. Baxter.

Mr. OSTRANDER. Now, I am not quite qualified insofar as the problems in Washington with reference to the SST. I think there were billions of dollars apparently being arranged, and that bill has not apparently gone through or has been stopped, and may I project to this committee that those funds be devoted to public works in all of the cities throughout the United States because we all need serious help, we all have problems, and, believe me, let us have that money and do something here in this country and do it in the right way so that we aren't faced with this ridiculous, stupid problem of ocean dumping.

Thank you very much, gentlemen, and I want to add one more thing; this afternoon or this evening we are to be honored in our city of Wildwood, with having the Honorable Senator Harrison Williams at a testi-

monial dinner given by our city, and Senator Jackson will be there, we hope. I have a plane outside, if you fellows would like to come over and have dinner with us, we would be terribly delighted.

Thank you very, very much. [Applause.]

(See appendix for additional materials supplied by Mr. Ostrander.)

Senator Boggs. Thank you very much, Commissioner Ostrander.

There has been a rapid expansion in the use of Delmarva beaches in recent years. I know the panel will discuss this point. But as a further indication of the popularity of this area, I recently obtained from the National Park Service figures on the number of visitors at Assateague Island. They show a dramatic increase in recent years. I think it would be helpful to include these visitor figures in the hearing record at this point to demonstrate the potential impact should offshore dumping at some future date affect the area beaches.

(The table follows:)

VISITOR-USE STATISTICS

Year:	Assateague Island National Seashore							
	Assateague State Park		Total		Maryland ¹		Virginia	
	Visitors	Camper days	Visitors	Camper days	Visitors	Camper days	Visitors	Camper days
1966.....	173,845	43,125	(3)	(1)	(1)	(1)	(1)	(1)
1967.....	269,079	56,453	738,700	287,436	321,408	287,436	417,292	(2)
1968.....	582,716	75,833	1,064,694	348,348	519,819	348,348	544,875	(2)
1969.....	1,012,948	107,934	1,360,554	*287,482	720,289	*287,482	640,365	(2)
1970.....	1,199,290	118,782	1,648,060	*99,142	822,819	*99,142	825,241	(2)

¹Seashore not in operation

*Camping accommodated by private campgrounds

*Decrease through limitation of camping capacity

Note: Assateague State Park and Assateague Island National Seashore have experienced a spectacular visitor-growth pattern since the beginning of operations as indicated in the above tabulations.

Senator Boggs. If there is nothing further at this time, we will recess until 2 o'clock.

(See appendix for additional materials submitted by SODA.)

(The subcommittee recessed the hearing at 1:10 p.m. to reconvene at 2 p.m.)

AFTER RECESS

Senator Boggs (presiding). The hearing will come to order.

I would like to take this opportunity to place several statements in the record. One is on behalf of Senator Eagleton, a valued member of this committee. He had hoped to be here today, but could not.

We also have a statement by the National Marine Fisheries Service biological laboratory in Oxford, Md.; a newspaper article from the Evening Journal, Wilmington, Del., dated January 18, 1971, as well as other newspaper articles bearing on this subject; a brief statement including a copy of a letter from J. W. Glasmann, president of the Sussex Shores Beach Association.

Because of the length of these various items we will include them in the appendix of today's hearing.

Senator BEALL. Mr. Chairman, may I also include an article from the Washington Sunday Star, February 21, 1971?

Senator Boggs. Without objection.

We are going to start with Capt. James L. Verber. Mr. Baxter yields to Captain Verber, who has to catch a flight to get back to Rhode Island.

Capt. James L. Verber is Chief of the Northeast Technical Services Unit, Division of Shellfish Sanitation, at Dansville, R.I.

Captain Verber, we are glad to have you here; your whole statement will be made a part of the record.

STATEMENT OF JAMES L. VERBER, CHIEF, NORTHEAST TECHNICAL SERVICES UNIT, DIVISION OF SHELLFISH SANITATION, FOOD AND DRUG ADMINISTRATION

Captain VERBER. Thank you very much, Mr. Chairman. I appreciate you taking me out of turn.

My name is James L. Verber. I am Chief, Northeast Technical Services Unit, Division of Shellfish Sanitation, Food and Drug Administration. My statement is made within the general framework of the national shellfish sanitation program—a consumer protection-oriented program administered jointly by the States and the Food and Drug Administration.

This program is directly affected when pollutants are deliberately or accidentally discharged onto the Continental Shelf which supports a valuable marine food resource. We have learned through our studies that the water quality levels and sediment composition affected by this pollution determines, in part, the sanitary quality of the shellfish beds and the habitats of other edible marine foods on the Continental Shelf. It follows then that the pollutants, such as sewage sludge and industrial wastes, will determine, in part, the sanitary quality of the shellfish and other marine foods in the area. Shellfish are filter feeders and concentrate pathogenic bacteria, viruses, toxic industrial wastes, and naturally occurring marine biotoxins. Some species are eaten raw or only partially cooked. Thus, bivalved mollusks, specifically oysters, clams, and mussels from polluted waters, may present an unusual potential for the transmission of disease to man.

The Food and Drug Administration, through its administration of the national shellfish sanitation program, has an obligation in the classification and control of shellfish-growing areas.

TECHNICAL ASPECTS

The fundamental principle in assuring safe shellfish production is the sanitary control of the overlying waters. Accordingly, State and Federal agencies responsible for sanitary control of shellfish must identify pollution sources, classify and delineate known polluted areas, and assure that shellfish are not harvested from such areas. Under program provisions, the shellfish-producing States are responsible for growing area classification and control within their territorial jurisdiction. The responsibility for control of shellfish-growing areas on the Continental Shelf beyond the States 3-mile jurisdictional limit is exercised by the Food and Drug Administration.

SHELLFISH AND OTHER MARINE FOODS AS A NATIONAL RESOURCE

The Continental Shelf and its biological population have long been recognized as a valuable food resource. Until recently, surf clams were considered as being geographically removed from sources of pollution. Dangers of contamination to the resource and harvesting areas were largely discounted. However, within recent years, the utilization of the sea for disposal of sewage sludge and industrial wastes have increased. Depletion of resources in the major harvest area off New Jersey and increased demand has caused the industry to expand its area of operation to the south in search of more productive shellfish beds. Likewise, heavy population and industrial growth along the coast have increased the amounts of chemical wastes, such as sewage sludge and other wastes being disposed of at sea. These factors have reached the point where the Food and Drug Administration posted a warning notice to harvesters of the closure of the two areas on the Continental Shelf to shellfishing.

Mr. Chairman, there are copies of the map of these closure areas on the table for distribution, and for the record.

One area is located in the New York Bight and the other is off Delaware Bay. Both of these areas are used as dump sites and are contaminated by sewage sludge. At the request of the Food and Drug Administration, routine patrols are conducted by the U.S. Coast Guard as a safeguard against harvesting within the closed areas.

(The notice and maps referred to follow:)

MAY 19, 1970

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

PUBLIC HEALTH SERVICE

FOOD AND DRUG ADMINISTRATION

NOTICE TO HARVESTERS

WARNING

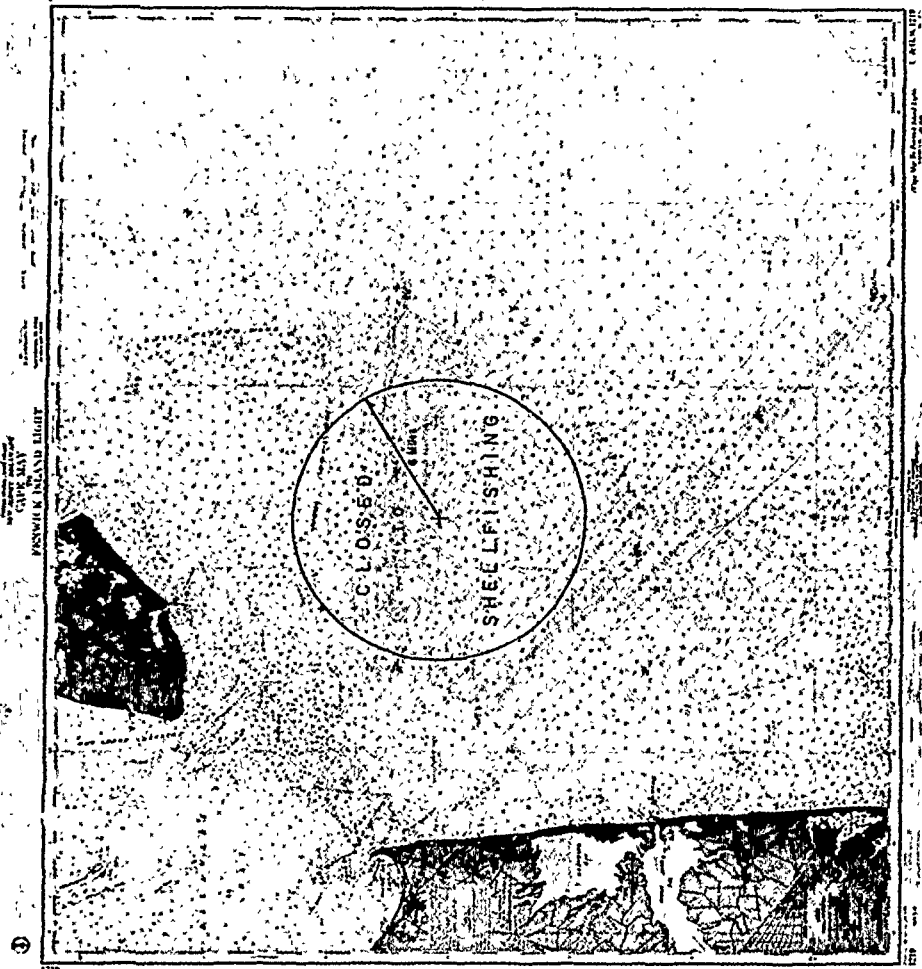
The Food and Drug Administration has found that the area shown on the reverse side is polluted and shellfish are contaminated. You are requested to exercise care and avoid harvesting in this area. This warning is issued under the responsibilities of the National Shellfish Sanitation Program. Persons desiring further information write:

Food and Drug Administration
Bureau of Foods, Pesticides, and Product Safety
Shellfish Sanitation Branch (BF-351)
200 C Street, S.W.
Washington, D.C. 20204

BE21 C02A VAVIFVBF



BEST COPY AVAILABLE



BEST COPY AVAILABLE

And I also have copies of the Coast Guard notice on the table.

When a patrol observes harvesting in a closed area, the name and port of the vessel is reported to the Food and Drug Administration. At the present time, there is little or no control over ocean waste disposal practices in either of these closed areas, or in the majority of the other ocean dump sites.

(Coast Guard notice follows:)

DEPARTMENT OF TRANSPORTATION,
U.S. COAST GUARD.

CCGDTHREE Notice 5921

Subj: Shellfishing Closure Areas; information concerning.

1. *Purpose.* To assist the Food and Drug Administration in monitoring fishing activity in the shellfish closure areas around the New York and Delaware sludge dump site.

2. *Cancellation.* CCGDTHREE Notice 5921 of 1 May 1970 is cancelled.

3. *Discussion.*

a. In an effort to prevent the harvesting of contaminated shellfish, closure areas have been designated around the sludge dump sites off the coast of Delaware and New York. The closures are described by an area of six nautical mile, radius from the center of each dump. The Delaware dump center is located at 38°45.6'N 74°47.3'W and the New York dump center at 40°25'04"N 73°44'53"W. The enclosed chartlets depict the closure areas.

b. Harvesting shellfish that may be contaminated is a concern to the consuming public and to the Food and Drug Administration for effective administration of the Federal Food, Drug and Cosmetic Act as amended, and the National Shellfish Sanitation Program. The surf clam industry is aware of the prohibition and is cooperating by restricting their harvesting to other areas. Commander, Third Coast Guard District has been requested to assist by verifying the surf clam area of activity.

c. Surveillance of these areas to date has provided valuable information regarding both the presence and absence of shellfishing in these areas. These reports are still required, however, the requirement to report negative sightings by message is eliminated. Positive sightings must continue to be reported by priority message to permit timely action by the FDA.

4. *Action.* a. All units transiting the closure areas during routine operations will note the presence or absence of shellfishing vessels.

b. Identify any vessels observed actually harvesting shellfish and advise the vessel of the violation if feasible. Send a priority message to Commander, Third Coast Guard District (oil) indicating vessel identity, position, time of sighting, whether observed harvesting and whether the vessel was notified of the violation.

c. Negative sightings need no longer be reported by message. Negative sightings during transit will be submitted monthly to CCGD3 (oil). The report may be informal and need contain only the unit name and time and date of which area transited. Units not transiting the area need not submit a report.

d. Upon receipt of the report, The District Commander (oil) will advise Chief, Northeast Technical Services Unit, Food and Drug Administration, Construction Battalion Center, Davisville, Rhode Island 02854. Telephone Number (401) 267-2307. Positive sightings will be passed by telephone and negative sightings will be mailed.

5. *Cancellation.* This notice will be cancelled when these provisions have been incorporated into the OPLAN or for record purposes on 31 December 1970.

ALBERT FROST,
Chief of Staff.

OCEAN DUMPING OF POLLUTED MATTER

The two types of ocean waste disposal affecting marine foods may be classified as fixed and mobile. The fixed sites are the shore or offshore outfalls discharging municipal and/or industrial wastes. Fixed sites lie within the 3-mile State territorial waters and thus are under State jurisdiction at this time. The mobile types are the offshore dumping sites for the disposal of industrial wastes, sewage sludge, dredge spoils, refuse—that is garbage—radioactive wastes, explosives, or toxic

RECEIVED JAN 10 1971

chemical munitions, and accidental spills, such as the *Torrey Canyon* oil disaster.

There are 281 known dump sites off the coast of the United States which have been in use during the past 15 years.

Senator Boggs. That is for both the east and west coasts?

Captain VERBER. Yes, sir. That is total, Senator.

One hundred and thirty-five sites, or 49 percent of the total, are on the Atlantic coast. Ninety-seven of the Atlantic locations are in waters shallow enough for molluscan shellfish harvesting, that is 200 feet or less.

I wish also to add a note here that they do harvest the offshore lobsters in 4,800 feet of water.

The remaining locations are in depths of 300 or more feet. The classifications that I have listed indicate the number and types of wastes on the Atlantic shelf where harvesting is feasible, which are less than 200 feet:

Type:

Dredge spoil ¹	83
Industrial wastes	12
Sewage sludge	2
Radioactive wastes	3
Explosive and toxic chemical munitions	1
Total	² 101

¹ There is an overlap of four sites.

² The Corps of Engineers considers that 45 percent of the dredge spoils dumped on the Atlantic coast are polluted.

Of the known 39 million tons annually dumped on the Atlantic shelf, some 45 percent, or 17.65 million tons, are dumped into the two areas now closed to shellfishing.

I wish to note that if we could box this up into cubic feet, that is 1 by 1 by 1, that amount would reach around the Equator 2½ times.

With a few exceptions, the remaining tonnage is dumped within the 3-mile limit. Two of these exceptions are the industrial dump sites activated in the past few years at 37 and 47 miles off the coast of Delaware.

Marine food species which may be harvested in the vicinity of ocean dump sites along the Mid-Atlantic, gulf, and Pacific coastal areas include surf and mahogany clams, lobsters, crabs, scallops, and various species of finfish.

STUDIES OF THE AFFECTED SHELLFISH AREAS

Initial studies in the New York Bight sewage sludge area were begun by the FDA's northeast technical services unit in May 1966. This site has been in operation since 1925. During fiscal year 1968, some 4.5 million tons of sewage sludge from 20 New York and New Jersey communities were dumped in the New York Bight area. Of this amount, 53 percent was raw sewage sludge.

These studies were extended the following year into the Delaware sewage sludge area. In 1969 and 1970, studies again were conducted in these areas. The data included physical, bacterial, and chemical studies of the sediments and shellfish meats, and bacterial studies of the water. These studies are being continued. Also covered in our investigations were the dump practices employed by barge operators and the degree of surveillance over these operations.

Barge-loading operations may not be confined to sewage sludge. Once the vessel leaves sight of land in either the Delaware or New York area, there is no intelligence system to assure that the load is dumped at the designated site. In one instance, a 2-month investigation, including detailed laboratory analyses, was necessary to demonstrate short dumping more than 7 miles from the designated site in New York. In the Delaware area, dumping was observed to occur more than 2 miles from the designated dumping site.

The present status of the Delaware area might be comparable to the status of the New York Bight site in the early 1930's. So you see what you have got to do or go to another Dead Sea area.

The Delaware area was opened for sewage sludge dumping in 1961 for the cities of Philadelphia, Pa., Camden and Bridgeton, N.J. They annually dump about 0.44 million tons of which 17 percent is raw sewage sludge, and I have noted this morning and was glad to hear that Bridgeton has stopped.

FDA studies in the Delaware offshore area were aimed at understanding existing problems. For example, clams were sampled at nine stations in an area adjacent to the dump site and showed positive coliform counts. The coliform group of bacteria is utilized as an indicator of pollution. Elevated counts were found in sampling stations 2 miles outside of the designated dumping area. A study of the sediments of the area showed elevated coliform counts in a 3-mile-wide band across the entire 12-mile closed area.

In addition, bottom water analysis indicated that positive coliform counts were randomly dispersed through the entire closed area. Chemical analysis of the surf clam meats collected from selected sampling stations contained relatively low levels of heavy metals although slight elevations were noted in the past few years for nickel and cobalt which could indicate a change in the characteristics of the waste being dumped.

SUMMARY

In summary, the Food and Drug Administration has found that the areas where sewage sludge is being dumped are polluted and shellfish are contaminated. A warning notice to harvesters with a map has been posted and distributed to the individual harvesters. Surveillance for possible encroachment of harvest vessels into closed areas is being maintained by the U.S. Coast Guard through routine patrols.

Other possibly contaminated dump sites in areas of known harvesting will be studied to ascertain their effect on the sanitary quality of the resource and appropriate steps will be taken to insure a safe product.

Thank you, very much.

Senator Boggs. Thank you, Captain.

Senator Buckley, do you have any questions at this point?

Senator BUCKLEY. No; thank you.

Senator Boggs. Senator Beall?

Senator BEALL. No, sir.

Senator Boggs. I appreciate your testimony, it is very valuable.

Are there any instances that you know of in which shellfish from the closed area have been marketed, affecting human health?

Captain VERBER. Since this notice has been posted we have had no harvesting vessel known in the area or reported to us.

Senator BOGGS. Captain, could you briefly describe what the ocean floor looks like in the vicinity of one of these sewage sludge dump areas?

Captain VERBER. Yes; it is difficult to not only describe the black sewage that is down there, Senator; it is also more difficult to describe the odor. The odor is extremely offensive such as you would normally find at a sewage treatment plant where raw sewage is discharged. It is indeed very foul. We have gone through several feet of it.

Senator BOGGS. Do you know what criteria is used in selecting a site for a sludge-dumping area such as the one off Delaware?

Captain VERBER. I do not know the criteria used by the Corps of Engineers in selection.

Senator BOGGS. I will ask them at the appropriate time.

From the dump site how far out do your studies show that the pollution spread?

Captain VERBER. As I have indicated, our studies have shown that a 3-mile-wide band in Delaware shows elevated coliform counts through the entire 12-mile zone. It probably extends to the deeper water on the southside and toward the shore where there is no harvesting at the present time. These studies are continuing and we will be working in that area.

Senator BOGGS. Thank you very much. I appreciate your being with us.

Captain VERBER. Thank you, Senator.

(Subsequent to Captain Verber's appearance, the following exchange of correspondence took place:)

U.S. SENATE, COMMITTEE ON PUBLIC WORKS,
Washington, D.C., April 13, 1971.

Capt. JAMES L. VERBER,
U.S. Public Health Service,
Chief, Northeast Technical Service Unit,
Danville, R.I.

DEAR CAPTAIN VERBER: On behalf of the Subcommittee on Air and Water Pollution, I wish to thank you for your useful contribution to our hearing on ocean dumping at Rehoboth Beach, Delaware.

In order to complete the hearing record, certain additional information would be helpful to clarify points made during testimony. Would you kindly supply us with written replies to the questions listed below at your earliest convenience?

Thank you for your cooperation.

Sincerely,

EDMUND S. MUSKIE, U.S.S.,
Chairman, Subcommittee on Air and Water Pollution.

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE,
PUBLIC HEALTH SERVICE, FOOD AND DRUG ADMINISTRATION,
Rockville, Md., May 11, 1971.

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: This is in reply to your request for additional information to clarify points made during the testimony of Capt. James L. Verber at Rehoboth Beach, Delaware.

QUESTION 1. There was some question raised during the hearing on how the FDA arrived at the figure of six miles for the radius of a shellfishing ban off the coast of Cape May. Could you describe the information used in arriving at this figure?

ANSWER 1. The six mile radius was chosen by the Food and Drug Administration to provide an adequate safety zone to prevent the harvesting of potentially contaminated shellfish. This safety zone was based on the following criteria :

(a) Known discharges of sewage sludge more than three miles from the center of the dump site.

(b) There are no controls over the barge operators to assure disposal at the proper site.

(c) Bacterial contamination in shellfish and sometimes bottom waters was consistently found at various locations at least two miles from the dump center.

(d) Hydrographic conditions indicate that the fine suspensions which can be found in sewage sludge are transported over great distances. At the bottom, the drift was shown by Malcolm Howe (1962) of Woods Hole Oceanographic Institute to be as much as 5.9 miles per day in this area.

(e) To allow a safety factor for navigational errors on behalf of the barge operators and the fishermen.

QUESTION 2. *It was suggested during the hearing that "conditional shellfishing" for cooked products be permitted in the contaminated area. Was shellfish contamination found to be by bacteria which can be killed by heating, or did contamination also include dangerous levels of heavy metals, pesticides, or viruses which are normally not removed by cooking?*

ANSWER 2. The FDA does not permit the cooking of filth (known fecal contamination) as shown by the bacterial counts. Under current knowledge, dangerous levels of heavy metals and pesticides were not found in the shellfish meats in the area.

QUESTION 3. *It was also suggested that FDA water samples may have been taken so close to the research vessel that samples could be contaminated by coliform bacteria from the vessel's waste water. Would you comment on this?*

ANSWER 3. Water samples were collected at the surface, middepth, and bottom during the first survey and bottom water only during the 1970 survey. During the first survey the highest bacterial counts were found in the bottom water and then at middepth and the lowest counts at the surface. It is inconceivable to assume that the waste water from the research vessel could contaminate the bottom waters during the time period the vessel was on station.

QUESTION 4. *Following Question 3, can we not assume that coliform bacteria counts in clams are taken up too slowly to be explained by research vessel waste?*

ANSWER 4. At the 50-foot to 80-foot depth in which the study was conducted it is extremely unlikely that any waste water could reach the bottom during the period of the sampling.

QUESTION 5. *Would you comment on the public health hazards of the proposal by Richard J. Sullivan (N.J. Commission of the Department of Environmental Protection) to use ocean outfall pipe lines to dispose of waste from Cape May County shore communities?*

ANSWER 5. If ocean outfall pipelines were constructed in the Cape May area, a closed safety zone would be required for each outfall. The safety zone size depends upon: size of population served; hydrographic factors around the outfall; reliability of the sewage treatment (if any); and operational and notification capability of all parties concerned in the event of some sewage handling failure.

QUESTION 6. *You stated that some lobsters are harvested at a 1,800 foot depth. Does this mean that waste dumping beyond the Continental Shelf is potentially dangerous to the lobster industry?*

ANSWER 6. The disposal of toxic industrial waste (mercury, arsenic, cyanide, etc.) poses a potential health hazard to any harvestable marine food product. The disposal of a toxicant at any depth could militate against the use of such an area for harvesting.

We will be pleased to answer any further questions.

Sincerely yours,

M. J. RYAN, Director,
Office of Legislative Services.

(See appendix for additional information relative to Captain Verber's testimony.)

Senator Boggs. Our next witness is Samuel Baxter, the water commissioner of the city of Philadelphia. Mr. Baxter, I think you sug-

gested that Dr. Robert A. Erb of the Franklin Institute Research Laboratory join you at the table. Doctor, come forward. You may proceed, Mr. Baxter.

STATEMENT OF SAMUEL S. BAXTER, COMMISSIONER AND CHIEF ENGINEER, PHILADELPHIA WATER DEPARTMENT, CITY OF PHILADELPHIA, PA.

Mr. BAXTER. We do have separate testimony but perhaps in the question period either of us might answer the questions.

Senator Boggs. Very good.

Mr. BAXTER. First of all, Senator Boggs and Senators of the subcommittee, as I sat at lunch over there today I was reminded of the old days in the Roman Colosseum when the Christians were sort of outside waiting to be thrown to the lions, and as I heard the testimony all morning I sort of had that kind of a feeling. On the other hand, I recall the fact that due to their martyrdom a very, very wonderful religion was established, and perhaps it is in that spirit that I will be testifying today with many, many different things from what has been testified to this morning.

My name is Samuel S. Baxter. I am commissioner and chief engineer of the Philadelphia Water Department. My written testimony gives some of my qualifications and I am going to pass over them, and Dr. Erb will, too. I would suggest to the committee that in testimony that has been received that sometimes the background and experience of the people are important.

Senator Boggs. Yes; we are going to make that part of the record.

Mr. BAXTER. The Philadelphia Water Department has the responsibility for design, construction, operation, maintenance, and management of the water system and waste-water systems in Philadelphia, and we are required to be self-sustaining and in this particular way all the charges for sewage services in Philadelphia are supported by separate charges for the citizens of Philadelphia. We have been working on this for a long time.

Since 1955 we have operated three water pollution control plants and those three plants now receive all the sewage from Philadelphia. My testimony shows in the written form that we now average about 428 million gallons daily; and I think it is worth saying that we now operate under a permit from the Pennsylvania Department of Environmental Resources. We are meeting the requirements of that permit and bettering the requirements by 20 percent. But we note also that we are under orders to upgrade those treatment plants with a schedule for October 1977, and for which there will be a capital charge of about \$175 million to upgrade the treatment plants. We are on schedule, but the work is scheduled for completion in 1977.

Now, beginning with 1923 and until 1961, all of the sludge from the Philadelphia treatment plants was put in lagoons on sites in Philadelphia and within the treatment plantsites. But beginning in 1961, all of the sludge since that time has been taken to sea, and I make a very important point—at least we think it is important—that all of that sludge was digested. I want to come to that in a minute.

Back in 1958, when the lagoons in Philadelphia started to become filled, we made an examination of various methods of disposing of our sludge. We had 14 different methods and, using one of the best con-

sulting firms in the country, our final decision was that barging to sea would not only be the most economical—that was one factor—but also a method that would cause a minimum of trouble with environmental problems. And then we chose a site in the Atlantic Ocean with some advise from people that knew something about the currents in the Delaware, and at times we hear different descriptions of where that site is. I point out that it is $11\frac{1}{2}$ nautical miles—the center of the site— $11\frac{1}{2}$ nautical miles off each of the capes at the mouth of the Delaware.

Actually the way we do it: We furnish the sludge in barges—two barges—which are operated by a contractor. From time to time we have made checks to see that the tug captains who pull the barge put this material in the proper area; also, our own chemists in the past have taken samples.

Our average over these past 10 years has been 70 million gallons a year. Our present contract will allow us to go up to 118 million gallons a year. The sludge is 90-percent water. This is not 90-percent treatment as someone testified this morning; this only indicates that this final sludge is 90-percent water.

It is respectfully suggested to the committee that although considerable emotion and heat has been aroused by the disposal of waste matter in the ocean, little or no attention has been paid by laymen to the fact that these wastes vary greatly in their composition and in their effects. There is a great deal of difference between the procedure which was once used by cities in dumping raw garbage on the surface of the ocean compared to sewage sludge; and there is also a decided difference between disposing of digested sewage and undigested sewage. And finally, there is the matter of the disposal of concentrated industrial wastes which have been discussed earlier.

Raw sludge—and I am going to put this in the testimony because I haven't heard it yet—raw sludge is the solid-waste material that settles out of raw sewage. In this raw sludge the bacterial content is extremely high and the waste is extremely unstable requiring tremendous quantities of oxygen and time for stabilization. The opportunities for disease organisms in this type of sludge are great.

I do suggest to you also that there are instances of disposal of undigested or partly digested sludge in the area of the ocean under consideration and which Philadelphia has used. I refrain from naming the places although I heard that testimony already.

Digested sludge, however, is the raw sludge that has been processed in Philadelphia a minimum of 50 days after its removal from the raw sewage. It has been subjected during that time to an anaerobic process and stabilized. The bacterial count has been drastically reduced and the material has been transformed into a stable humus-like material. It is 90 percent water and 10 percent solid, and half of that 10 percent solid is no more than earth and sand and the remaining 5 percent is organic matter very similar to the humus that one might use as a soil conditioner.

When we made our original decision to dispose of the digested sludge at sea we considered, as one of the factors, that the minerals and the organics in the sludge would have beneficial effects on the ocean. It is suggested that an ideal waste disposal system is one that processes a waste into a form that can be used by nature, and this is the process generally referred to as recycling, and in disposing of digested sludge at sea we think we are doing just that.

I point out to you this afternoon, and I know there was some other testimony this morning by some people that seemed to be opposite, that there are many cases where digested sludge has been used to increase the yield of farmland. One illustration that has come recently, that out of Chicago, they are taking some of their sludge, taking it down country to some wasteland in Illinois where they have had a remarkable increase in corn crop growing.

In Philadelphia we don't have at our disposal any access to land which would permit the disposal of sludge in this manner. We do know that the ocean has the ability to assimilate waste which it does when fish or other aquatic life die. The ocean has this mechanism to transform this dead organic matter, biologically, in the same manner that we transform raw sludge to the form in which it can be used.

We suggest that this disposal of digested sludge in the ocean should be helpful to fish and other aquatic life. If we stop the disposal of digested sludge at sea, we would be abandoning a legitimate method of recycling.

As an aside, but as an important factor, it would also add to the cost to Philadelphians for the disposal, and it seems to us it would be wasteful to abandon an economical method without sufficient evidence that the waste is harmful to the ocean.

We can't help but be aware, because we have attended meetings of a considerable concern expressed by the citizens about our environment, but at the same time I am concerned that we do not overact in this matter and not only expend our resources—whether or not needed at the present time—but also that we might waste some of the natural resources. As an example, the alternatives in this location from Philadelphia to the disposal of ocean sludge is some type of incineration which does not return to the environment in a usable way some of the material that is available in the ocean.

Late last year the National Academy of Sciences and the National Academy of Engineering published a report entitled, "Wastes Management Concepts for the Coastal Zone." It is a learned study on the problems of disposal of wastes in the oceans but if there is one thing which extends throughout the entire report it is that considerable study and research is needed before we can come to definite conclusions in this matter.

Because the water department has recognized the need for further information, study and research, and because we cannot help but be aware of the concerns of many people, we have embarked on a study of our ocean disposal procedure and its effects on the ocean and the surrounding areas. At a cost of \$70,000, all of our own money, we have contracted with the Franklin Institute and with the Thomas Jefferson University to make a complete study of the area in which we dispose sludge, and of the surrounding ocean and coastal areas. This work started in January of this year and will take approximately 1 year to complete.

And I would add the point that if, as time goes on, and it seems desirable, we will even contract and spend more money on our own to find out what goes on.

Your committee has invited directly the representatives of Franklin Institute and Dr. Erb will testify on what has happened to date. But in general we have asked the Franklin Institute to determine the pre-

dominant surface and bottom currents and analyze the bottom sediment and area water for toxic content, for dissolved oxygen, bacterial content and the condition of aquatic life.

I heard someone say today there was no dissolved oxygen, we have tested it and we know that this is not true.

Thomas Jefferson University, which is attached to the Jefferson Hospital in Philadelphia, is going to perform specialized bacterial work to determine if disease organisms are present in the site, in the sediment, in the waters and aquatic life. We think that some of the work we are doing there, particularly when it gets along to viruses, is work that no one else has been doing so far. If they have, we haven't run into it.

As we received the work which has been done on bacterial tests of surface, midway and bottom, none have shown the presence of *E. coli* which are the bacteria used to indicate the possibility of the presence of disease producing organisms. Dr. Erb will discuss that further.

Samples were also analyzed for the presence of many of the heavy metals. In a total of 72 tests, all but one showed that from a bacteriological and a heavy metal standpoint, this water would more than meet the U.S. Public Health drinking water standards.

Metals were found in some of the bottom sand and mud at a few locations which exceeded drinking water standards, but it is suggested that the use of drinking water standards, to judge the condition of mud and sand, is an extremely severe test and we used it only to emphasize the absence of any deleterious matter.

In view of the fact that a complete study is underway for us by two unbiased and highly regarded scientific organizations, each of whom has complete freedom to report the facts as they see them, and in view of the recommendations in the report of the National Academy of Science and the National Academy of Engineering, that much more research is needed, it is my suggestion and hope that none of the agencies which have or may have jurisdiction should take hurried action. Full and complete study of the matter is certainly warranted. In my opinion such studies should not only look into the matter of the effects of the disposal of Philadelphia digested sludge in the ocean, but should also take a look at the problems which occur with the disposal of undigested sludge and other waste matters. And I also suggest that any complete study of this problem should also cover the procedures used for the disposal of waste—not necessarily sludge, waste—from nearby communities in the vicinity of the Philadelphia disposal area.

Remember, gentlemen, or perhaps I can recall to you, that the liquid disposal from primary plants, of which there are many in this area, also contains the raw matter, a considerable amount of it, and, of course, we are talking about using digested sludge.

It may be self-serving to say so, but I am going to say so, that we have prided ourselves in the Philadelphia Water Department on our high engineering and scientific approach to those problems. We chose the present site after consideration of the factors which were known at the time. We have done some monitoring ourselves and we now have contracted at a reasonably large cost to thoroughly examine it. But I will go one step further and say this, and make this plain; if our studies indicate any reasonable or substantial harm to the ocean area because of our disposal of digested sludge at the present location we,

of our own volition, will take the necessary steps to find other areas at which no harm will be done. We will do this regardless of whether we are ordered to do so or not. But at the same time we do want to object to any procedure requiring us to change location or to large expenditures when this is based on emotion rather than on substantial facts.

Thank you.

(Prepared statement of Mr. Baxter follows:)

PREPARED STATEMENT OF SAMUEL S. BAXTER

My name is Samuel S. Baxter. I am Commissioner and Chief Engineer of the Philadelphia Water Department. I am a registered professional engineer and have had contact at various levels with the problems of sewage treatment and disposal for 40 years. I have been directly involved with this problem in Philadelphia since 1946 and have been in full charge of the Water Department since 1952.

In addition to my work in Philadelphia, I have been involved in work in the field of water resources and waste disposal in various professional and governmental organizations. I have been national President of the American Public Works Association, the American Water Works Association, and the current President of the American Society of Civil Engineers. I served for two years as a member of the National Water Commission and have served on a presidential mission to Germany. For the past 8 years I have been the official advisor to the Pennsylvania member of the Delaware River Basin Commission. I have written and published many articles in the field of water resources and waste water disposal and especially those involving management of these resources.

The Philadelphia Water Department has the responsibility for design, construction, operation, maintenance and management of the water and waste water systems in Philadelphia including the storm water system. It is required by law to be completely self sustaining through specific rates and charges made for water and sewer services. It maintains a professional staff of engineers, scientists and other professionals to enable it to carry on its work. The department does considerable research work, has a 12 man unit assigned fully to this type of work, in addition to the research work done by the regular operating divisions. The Water Department and its predecessor department have carried on intensive research and study work since 1912, and published one of the earliest and most complete reports of any municipality in the United States in the field of waste disposal.

Since 1955 Philadelphia has operated three water pollution control plants which are capable of treating all of the sewage from Philadelphia and from some of the surrounding communities. The total amount treated averages 428 million gallons daily. Approximately 40% of this sewage is treated in a plant which is of the intermediate type and the remaining sewage is treated in two other primary type plants.

At the present time these plants, which operate under a permit from the Pennsylvania Department of Environmental Resources, are meeting the requirements of this permit and are bettering it by approximately 20%. The Water Department is under order, however, from the Commonwealth of Pennsylvania and the Delaware River Basin Commission to upgrade all three treatment plants, with a schedule that calls for completion and operation of the new facilities by October 1977. The preliminary engineering work has been under way for approximately one year and we are on schedule in this program.

Beginning with the operation of the first treatment plant in Philadelphia in 1923 and extending through the time of the operation of the present three plants until 1961, sludge from the treatment process was discharged to lagoons in low lying areas within the treatment plant sites. Since 1950, all of the sludge which has been produced in Philadelphia plants has been completely digested.

Beginning in 1958 studies were made to determine a new method of sludge disposal since the land area used for lagooning at the treatment plants was rapidly becoming exhausted and would not be able to take additional sludge after 1960. A full and complete study of all methods of sludge disposal was made by the Philadelphia Water Department in conjunction with Greeley and Hansen, consulting engineers, of Chicago. Fourteen different methods of disposal of sludge were thoroughly studied and the final decision was made that barging to sea

would be not only the most economical but also a method which would cause minimum environmental problems.

Prior to a decision on the actual location of the disposal site in the Atlantic ocean, discussions were held with knowledgeable people who were familiar with the Delaware estuary and the ocean in the vicinity of the mouth of the Delaware. The site which was chosen was a point $11\frac{1}{2}$ nautical miles off Cape May and $11\frac{1}{2}$ nautical miles off Cape Henlopen. The decision to use this method of disposal and the location itself was made by me after full discussion of all of the factors including any possible danger to health or harm to the ocean.

In practice the sludge is delivered by the Philadelphia Water Department to barges which are furnished by a contractor who hauls the barges to the disposal site in the ocean. From time to time we have made checks to make certain that the actual disposal site was used. We have also, from time to time, assigned chemists to take samples of the sea water and have not detected any harmful changes.

The average amount of sludge which Philadelphia has disposed at sea since 1961 is 70 million gallons a year of digested sludge. The present contract permits the transportation of up to 118 million gallons per year. It is noted that this sludge averages 90% water.

It is respectfully suggested to the Committee that although considerable emotion and heat has been aroused by disposal of waste matter in the ocean, little or no attention has been paid by laymen to the fact that these wastes vary greatly in their composition and in their effects on the ocean. There is a great deal of difference between the procedure which was once used by cities in dumping raw garbage on the surface of the ocean when compared to the disposal of sewage sludge. There is also a difference between disposing of digested sewage sludge and undigested sewage sludge, and finally there is the matter of the disposal of concentrated industrial wastes which vary considerably from sewage sludge, and with a wide variety in these wastes themselves. I shall confine my remarks to those things which are affected by sewage sludge.

Raw sludge is the solid waste material that settles out of raw sewage. In this raw sludge the bacterial content is extremely high and the waste is extremely unstable, requiring tremendous quantities of oxygen and time for stabilization. The opportunity for the presence of disease organisms in this type of sludge is great. It is suggested to the Committee that there are instances of the disposal of undigested or partly digested sludge in the area of the ocean which is under consideration by the Committee at this hearing.

Digested sludge is raw sludge that has been processed in Philadelphia a minimum of 50 days after its removal from the raw sewage. During this time it has been subjected to an anaerobic process and stabilized. Bacterial count has been drastically reduced and the material has been transformed into a stable humus-like material.

As indicated earlier, digested sludge is 90% water and 10% solid material. Half of the solid material is nothing more than earth and sand and the remaining 5% of the total sludge is organic matter very similar to the humus one might use as a soil conditioner. In making our original decision to dispose of digested sludge at sea we considered, as one of the factors, that the minerals and organics in the sludge would have beneficial effects. It is suggested that an ideal waste disposal system is one that processes a waste into a form that can be used by nature. This is the process which is generally referred to as recycling and in disposing of digested sludge at sea, we believe that we are doing just that.

There are many cases where digested sludge has been used to increase the yield of farmland. One specific illustration at the present time is the disposal of some of digested sludge from the Chicago plants on low producing land in Illinois. Reports that we have seen indicate that corn production has been increased to 36 bushels per acre on this poor land after digested sludge has been placed on it.

Philadelphia does not have at its disposal any access to land which would permit the disposal of sludge in this manner. We do know that the ocean has the ability to assimilate waste which it does when fish and other aquatic life die. The ocean has the mechanism to transform this dead organic matter biologically in the same manner that we transform raw sludge to a form in which it can be reused.

We suggest that the disposal of digested sludge in the ocean should be helpful to fish and other aquatic life. If we stop the disposal of digested sludge at sea we would be abandoning a legitimate method of recycling but in addition would add considerably to the cost of waste treatment for the people of Phila-

delphia. It would seem to be wasteful to abandon an economical method of waste disposal without sufficient evidence that the waste is harmful to the ocean.

We cannot help but be aware of the considerable concern expressed by citizens about our environment. At the same time I am concerned that we do not overact in this matter and not only expend our resources where they are not needed at the present time, but also that we might waste some of the natural resources. As an example the alternative in this location to ocean disposal of sludge is some type incineration of sludge. Ocean disposal makes it possible to return valuable natural elements to the environment.

Late last year the National Academy of Sciences and the National Academy of Engineering published a report entitled, "Wastes Management Concepts for the Coastal Zone." It is a learned study on the problems of disposal of wastes in the oceans but if there is one thing which extends throughout the entire report it is that considerable study and research is needed before we can come to definite conclusions in this important matter.

Because the Water Department has recognized the need for further information, study and research, and because we cannot help but be aware of the concerns of many people, we have embarked on a study of our ocean disposal procedure and its effect on the ocean and surrounding areas. At a cost of \$70,000 of our own money, we have contracted with the Franklin Institute and with the Thomas Jefferson University to make a complete study of the area in which we dispose sludge, and of the surrounding ocean and coastal areas. This work started in January of this year and will take approximately one year to complete.

Your Committee has invited directly the representatives of Franklin Institute to testify before you today. They can indicate to you what they have done until this time and some results of their studies to date. In general we have asked Franklin Institute to determine the predominant surface and bottom currents and to analyze the bottom sediment and area water for toxic content, dissolved oxygen, bacterial content and the condition of aquatic life. Thomas Jefferson University will perform specialized bacteriological work to determine if disease-causing organisms are present in the disposal site, sediment, waters, and aquatic life.

As we have reviewed the work which has been done on bacterial tests of surface, midway and bottom samples, none have shown the presence of *E. coli* which are the bacteria used to indicate the possibility of the presence of disease-producing organisms. Samples were also analyzed for the presence of such metals as cadmium, hexavalent chromium, nickel, lead, manganese and zinc. In a total of 72 tests all cases but one showed that from a bacteriological and heavy metal standpoint, this water would more than meet United States Public Health drinking water standards.

Metals were found in some of the bottom sand and mud at a few locations which exceeded drinking water standards, but it is suggested that the use of drinking water standards, to judge the condition of mud and sand, is an extremely severe test and was used only to emphasize the absence of any deleterious matter.

The representative of Franklin Institute will describe to you in more detail the work which they have done up to the present time which includes surveys of surface drifters and bottom drifters. Although their work is far from complete at the present time, there is nothing which has been found to date which would cause me to feel that our original decision was in error in believing that our disposal of digested sludge in the ocean at this location would be harmful.

In view of the fact that a complete study is under way for us by two unbiased and highly regarded scientific organizations, each of whom has complete freedom to report the facts as they see them, and in view of the recommendations in the report of the National Academy of Science and the National Academy of Engineering, that much more research is needed, it is my suggestion and hope that none of the agencies which has or may have jurisdiction in this problem should take hurried action. Full and complete study of the matter is certainly warranted. In my opinion such studies should not only look into the matter of the effects of the disposal of Philadelphia digested sludge in the ocean, but should also take a look at the problems which occur with the disposal of undigested sludge and other waste matters. It is suggested also that any complete study of this problem should also cover the procedures used for the disposal of waste from nearby communities in the vicinity of the Philadelphia disposal area.

It may be self serving to say so, but the Philadelphia Water Department has prided itself on its high engineering and scientific approach to the problems of

water supply and waste disposal. It chose the present site for disposal after consideration of the factors which were known at the time and with our belief that there would be no harmful effects. We have done some monitoring ourselves and have now contracted at a reasonably large cost to more thoroughly and completely examine our position. In doing this we have also kept in mind the actual cost of this work which must be born by people in Philadelphia.

I can go one step further, however, and make this point. If our own studies indicate any reasonable or substantial harm to the ocean area because of our disposal of digested sludge at the present location, the Philadelphia Water Department of its own volition will take the necessary steps to find other areas at which no harm will be done. We will do this regardless of whether we are ordered to do so, but at the same time we will certainly object to any procedure requiring us to change location or to large expenditures when this is based on emotion rather than substantial facts.

Senator BOGGS. Thank you, Mr. Baxter.

Do you want to ask any questions at this stage, Senator Buckley?

Senator BUCKLEY. If I may, I would like to ask a couple questions; No. 1, is the site that you have described for Philadelphia dumping the same one which was described by Captain Verber?

Mr. BAXTER. I believe it is. There is one site that is well known, it is marked on all the charts and I am sure it is the one that was marked on his chart. I haven't seen his chart but I am quite sure it must be.

Senator BUCKLEY. I am concerned about the apparent conflict in your respective testimonies about bacterial presence. Apparently he suggested there is a need to outlaw the collection of shellfish in this area. I wonder if you might comment on this?

Mr. BAXTER. Only this, and I will let Doctor Erb testify, but we have been out there now since January making regular tests. Doctor Erb will actually show you bottom samples. Let me comment on one thing; we know we don't get a chance to cross examine but in answer to your question I am almost cross examining. Do you remember the comment that the material was smelly and dirty and black? Well, I have to say to you, gentlemen, that can't be digested sludge. Digested sludge does not have that smell, the hydrogen sulfide smell that is involved, it has to be from something else.

Senator BUCKLEY. In the tests that you are conducting now, are you also testing the shellfish to find out—

Mr. BAXTER. This will be part of the work that we are doing and this is why we have the hospital laboratory working. There will be tests made on shellfish and other aquatic life to determine not only bacteriological content but, we are even going as far as testing for various in the work that we plan to do under contract with the two institutions.

Senator BUCKLEY. Out of curiosity, if other people are dumping in the same area, how would you identify Philadelphia sludge from somebody else's sludge? [Laughter.]

Mr. BAXTER. Your comment causes laughter and this is one of the problems that we have. We went out there in 1961 knowing that we were taking digested sludge out and with our own opinion, which we have backed up, that this was not going to cause any harm. Now, after that, we have other communities who go out and dump undigested sludge. The point I tried to make in my testimony to the committee, and as you may write laws is that there is an awful lot of difference between digested and undigested sludge. And the old saying is, let's not throw the baby out with the bath water.

Senator BUCKLEY. I appreciate your pointing out that there are different sludges, some treated in one way and some coming from dif-

ferent origins; are you able to keep a pretty current control over the content of your heavy minerals, heavy metals, rather, in your sludge?

Mr. BAXTER. The kind of control we have to keep is this; Philadelphia is a large industrial city and we take waste into our treatment plants from all of the industries that are in the city, therefore, we can't say that we have complete control. For any of the metals or wastes that we think are toxic we try, through our own industrial waste division—and we think we have succeeded—in keeping them out of the sewage treatment plants. This doesn't mean that there are not heavy metals that go through because we know that there are some. Drs. Erb is going to show you in his testimony that as we tested even the bottom out here that the amounts of many of these heavy minerals in the bottom sediments samples are very minimal.

Senator BUCKLEY. One thing that concerns me is the criteria that were applied—perhaps I should say what criteria were applied for the protection of this specific site?

Mr. BAXTER. This decision was made about 12 or 13 years ago. At that time I particularly used a person who had just retired from the Corps of Engineers, I believe, but who had done a considerable amount of work in the Delaware on the models and other such things, and we picked a site which we thought was far enough off but in such a location where the depth—and the depth runs 65 feet average, I think, approximately—and where, if there were any slightest chance of this material coming back that the general ocean currents might take it out. That was the thing that we discussed at the time. The particular science of this has developed in the last 10 or 11 years. I still think that for a near-in site, as compared to a hundred miles, that this was a reasonably good choice.

Senator BUCKLEY. Did you take into consideration that the site happened to be in a known shellfish area?

Mr. BAXTER. No, I can't say—I have to say I can't recall that and if I can't recall it I would think that perhaps we did not know that. Remember that this material is highly divided matter, practically inert, and we will want to show you actually some of the things we have taken off the bottom.

I am going to suggest this, if I can; if you have to leave, Senator Buckley, I would like Doctor Erb to show you a natural sample of material that he has taken from the bottom which he would be talking about a little later but you might like to see it.

(A sample from station No. 13 was exhibited to the committee.)

Senator Boggs. Thank you, Mr. Baxter.

Now, we will proceed with the testimony of Doctor Erb from the Franklin Institute.

Doctor, go ahead.

**STATEMENT OF DR. ROBERT A. ERB, PRINCIPAL SCIENTIST,
CHEMISTRY DEPARTMENT, THE FRANKLIN INSTITUTE RE-
SEARCH LABORATORIES, PHILADELPHIA, PA.**

Dr. ERB. Thank you, Senator Boggs.

My name is Robert A. Erb. I have a Ph. D. degree with a major in physical chemistry and 17 years multidisciplinary experience in the Franklin Institute Research Laboratories, presently holding the title

of principal scientist in the chemistry department. For the past 4 years, I have been involved in studies on waste management as it relates to the ocean environment, particularly the Continental Shelf and upper continental slope regions. Since late fall 1970, I have been associated with an extensive FIRL-proposed study of the Philadelphia sludge disposal area. This study is sponsored by the city of Philadelphia, with minor additional support from the Pennsylvania Science and Engineering Foundation through the Institute for the Development of Riverine and Estuarine Systems.

In early 1970, news reports^{1 2} described "dead Sea" areas associated with dumping about 10 nautical miles from shore of sewage sludge from metropolitan New York treatment plants. The primary research results on the disposal areas were in a report³ by the Sandy Hook Marine Laboratory to the U.S. Army Corps of Engineers. Such things were found as: black sludges over a large area often more than 15 centimeters thick, and invariably containing large amounts of human artifacts, cigarette filter tips, band aids, et cetera; lowered dissolved oxygen levels in the overlying bottom waters; high concentrations, sometime over 100 parts per million, of copper, lead, and chromium in the sediments; and one area of about 5 square miles almost devoid of normal benthic macrofauna.

In view of these findings it is not surprising that interest has developed about the possible effects of Philadelphia's decade-long ocean disposal of sludge. What is surprising to me, however, is that uncritical direct comparisons have been made which assume the same conditions exist in the Philadelphia disposal area as in the New York area; this, in spite of the fact that the conditions are significantly different. Specifically, first, Philadelphia has been barging only digested sludge, a relatively inert material which has undergone a 25-day anaerobic digestion process followed by aging for several months in a lagoon, whereas the New York material is largely raw sludge, a bacteria-laden mixture with rapid oxygen demand.

Second, the New York volume is about eight times that of the 118 million gallons per year of Philadelphia, and deposited in a similar size disposal area.

Newspapers have reported what some say is going on off Delaware Bay, and I quote:

"* * * the sea is dead off your coast and the killer may soon float onto your Delaware Beaches." "* * * there might not be a 1971 tourist season." "* * * (the sludge) lies on the surface (of the bottom) and could be blown onto the beaches during a storm." "At the mouth of the bay the sewage sludge is said to cover about 12 miles and in some places it is several inches thick."⁴ "* * * the seabed has been turned into a desert." "The clams are now buried deep in odorous, deadly sludge."⁵

¹ Jack Anderson, "Sewage, Muck Are Killing Sea Life Off N.Y. and N.J.," *The Evening Bulletin*, Philadelphia, Pa., Feb. 10, 1970.

² Lore Fiedler, "Vast Ooze Blackens the Sea Off New York," *The National Observer* 9, No. 10, 6 (1970).

³ The Sandy Hook Marine Laboratory, "The Effects Of Waste Disposal In the New York, N.Y. Bight—Interim Report for January 1, 1970." A report to The Coastal Engineering Research Center, U.S. Army Corps of Engineers, Washington, D.C., Dec. 8, 1969.

⁴ "Coastal Waters of State Called a Dead Sea," *Evening Journal*, Wilmington, Del., Dec. 9, 1970.

⁵ Editorial, "Turning the Ocean Into a Desert," *Washington Star*, Washington, D.C., March 11, 1971; reproduced also as a guest editorial in the *Philadelphia Inquirer*, Philadelphia, Pa., March 23, 1971.

I might conclude here the publicized⁶ clamming-vessel trip last month to the "dead sea" one which Dr. Gordon MacDonald stated, "It looks like digested sewage sludge to me," when a rotten-egg-smelling mass was dredged up after two tries had brought up rocks and clay. I would note two things which suggest that the case for a sludge blanket here is less than proved:

First, dark, H_2S -smelling muck occurs naturally a number of places in the estuarine and ocean waters, quite apart from man's waste disposal. We, in an earlier study, even once found H_2S -smelling material 80 miles from shore.

Second, in the New York study, human artifacts were invariably found in the sewage sludge deposits. These were absent here. We have been unable to obtain the location of this dredging so that we might check it further.

To find out what is really happening in the sludge disposal area is an aim of our program. This includes a definitive measurement of the environmental conditions in and around the present site, with reference to various time frames, with emphasis on how these conditions might relate to assimilation of the materials into the environment, and also ecological effects, particularly on benthic organisms.

Figure 1 shows the rectangular disposal area with respect to Cape May and Cape Henlopen. You can see it on the lower part of the picture there. Contrary to some loosely reported distance figures, such as $5\frac{1}{2}$ miles from Cape May, the sludge disposal area is centered about $11\frac{1}{2}$ nautical miles, or 13 statute miles, from Cape May. The closest point of the disposal rectangle to Cape May is 12.4 statute miles—that is the kind you use when you are driving your car, you know—and to Rehoboth Beach is 14.5 statute miles.

⁶ Per-Otto L. Erichsen, "Nixon Aide Says U.S. Law Would Curb Sea Dumping," the Sunday Bulletin (N.J. Edition), Philadelphia, Pa. Feb. 28, 1971.

⁷ Wally Judd, "'Very Sick Clam' Dump's Only Life," Evening Journal, Wilmington, Del., Feb. 27, 1971.

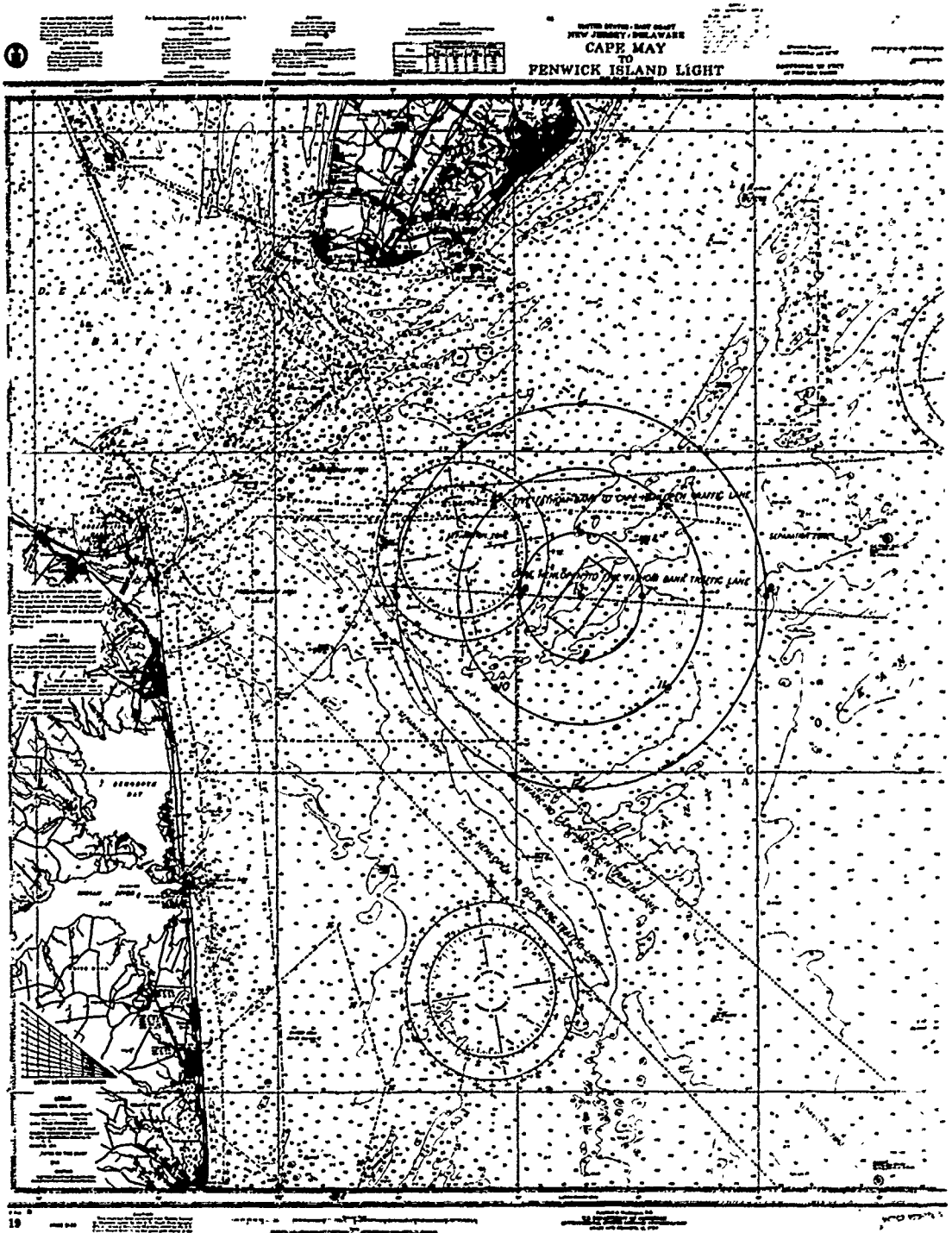


FIGURE 1.—Chart showing location of rectangular area for sludge disposal in relation to Cape Henlopen and Cape May.

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Figure 2 shows the 13 stations which we have started with in our systematic study; we use loran for position determination. The outer circle corresponds with the 6-mile radius of the FDA shellfishing ban.

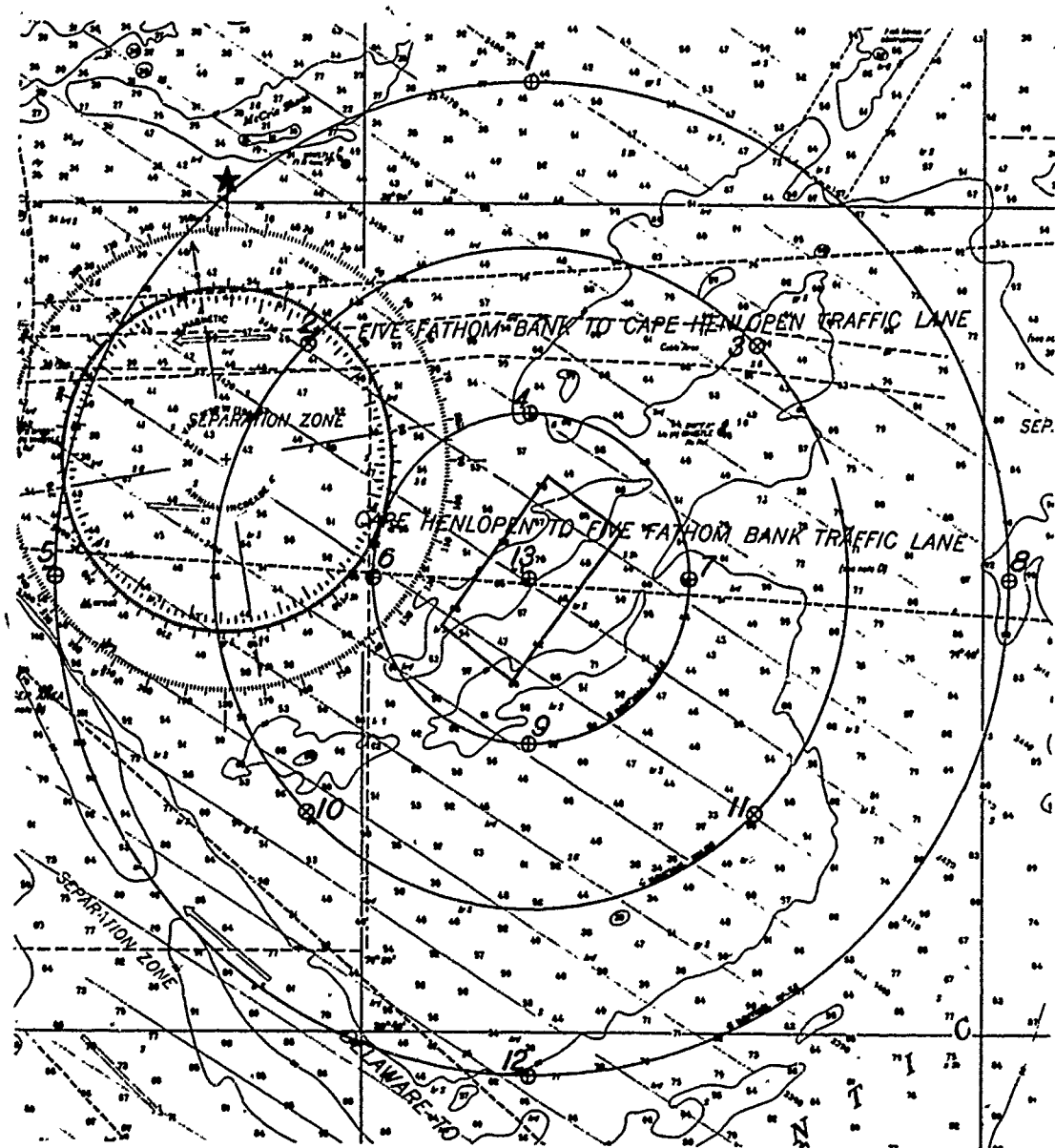


FIGURE 2.—Chart detail showing the 13-station arrangement used in the Franklin Institute study (depths in feet).

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In our study program in the ocean, which is being carried out in cooperation with the Marine Science Consortium, we have completed the first 3 monthly research cruises, January 23, February 21, and March 14, this year, out of 12 scheduled. The following information then is from a program which is in progress.

(1) *Sampling Bottom Sediments.* We have taken a total of 14 sets of sample distributed among 10 locations on the three trips, using a LaFond-Dietz grab, with additional use of a dredge or corer where appropriate. The samples taken from station 13—which we did on all these trips, by the way—which is the center of the disposal site, and the immediate environs, including low spots, have consisted of clean sand, along with gravel and shell fragments.

Figure 3 is a photograph of a typical station 13 sample. Bottom samples have also been taken so far at stations 1, 2, 4, 5, 6, 7, 9, and 12. Clean sand, sometimes with gravel and shell fragments, was found at each of these locations.



FIGURE 3.—Bottom sample from station 13 (January 23, 1971).

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Figure 4 shows a grab sample from station 7; 4-A shows one from station 5; 4-B from station 12. We have with us today frozen bottom samples from each of the above stations, all the stations that we have looked at right here, for those who would like to look at them. We found no black sludge, or anything close to it, and no sediments with an H_2S odor.

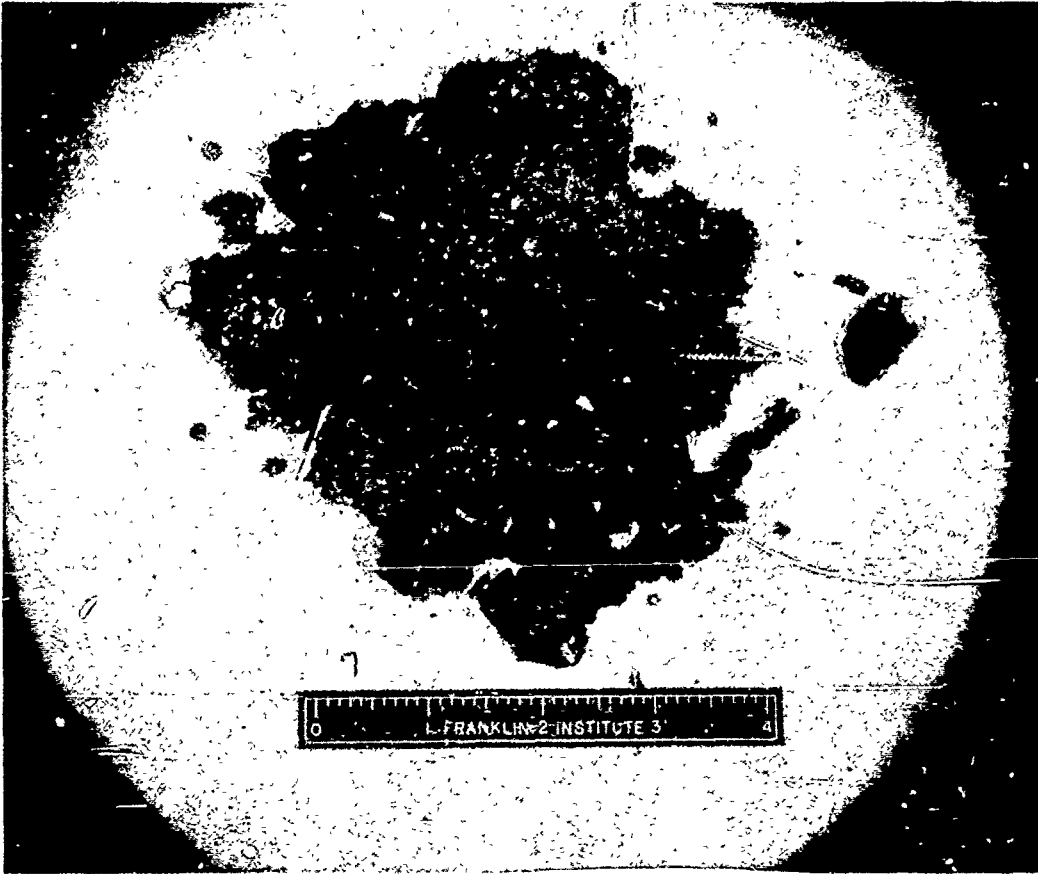


FIGURE 4.—Bottom sample from station 7 (January 23, 1971).

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My tentative explanation for this is that with the carefully controlled Philadelphia digested sludge procedure, the ocean is able to recycle and reuse these materials as fast as they are added.

(2) *Biological Sampling of the Bottom*. By means of the grab, various dredges and an otter trawl, specimens of benthic macrofauna were found. At station 13, the center of the disposal area, we have found starfish, sand dollars, clams (*Astarte* species), hermit crabs, snails, and two calico crabs which were brought up on a fishing line. The specimens were not only alive but were also healthy, judging from appearance and activity.

Figure 5 shows life forms from one biological dredge at station 13. And you can see in there small ghost shrimp, some little hermit crabs that were very lively; there is one starfish over there, some worm tubes, and a sand dollar in the middle.

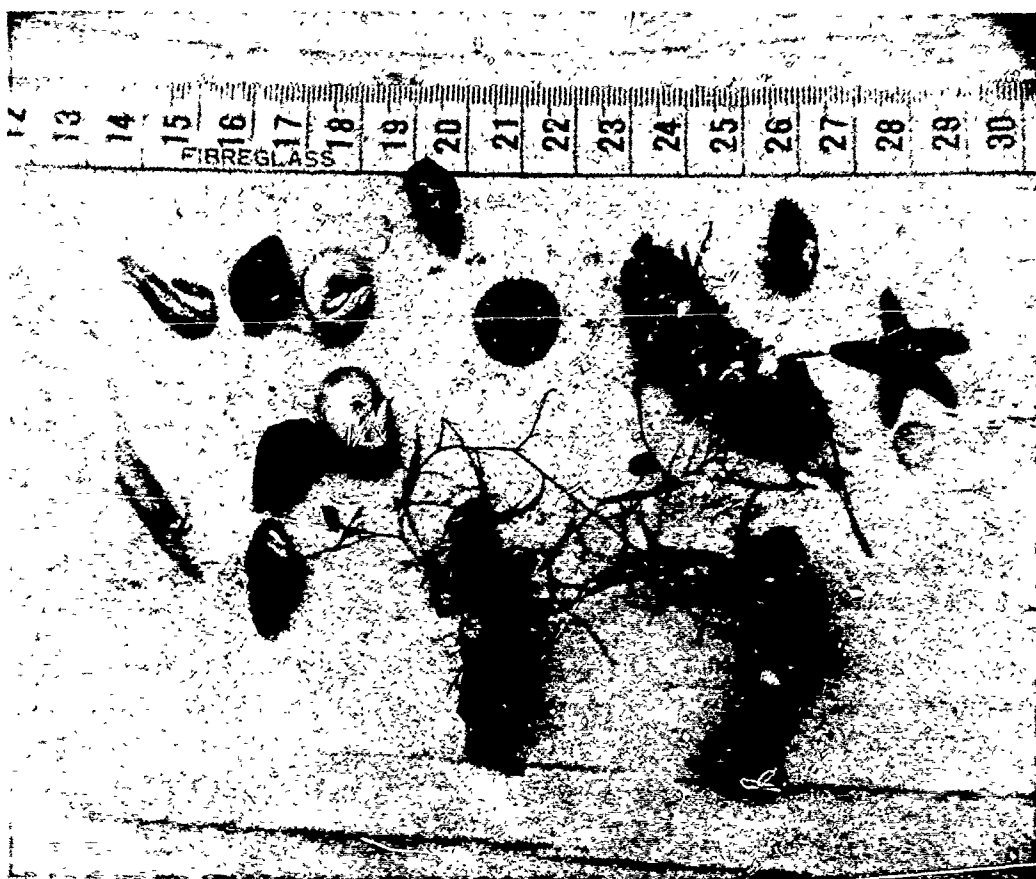


FIGURE 5.—Specimens recovered in a biological dredge in the vicinity of station 13 (March 14, 1971): includes sand dollar, starfish, ghost shrimp, and hermit crabs.

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Normal sea life appears to be present at all stations. Fish specimens by trawl include winter flounder, transparent flounder, and long-horned sculpin.

(3) *Coliform Tests*. Determinations have been made for fecal and total coliform on some 34 water samples representing bottom, middle, and top water at nine stations, with some stations repeated on successive trips. The results were zero coliform on all samples. This encouraging result is not completely surprising, since coliform bacteria die off very rapidly in ocean water. The time for 90 percent killoff for *E. coli* in the sea water is 1 to 6 hours.⁸ We are presently extending the coliform studies to sediments and clams in view of reports⁹—and we heard one earlier—that these can test positively for coliforms when the overlying sea water is negative. There is a strong possibility that the cessation of dumping of raw or partially digested sludge by Bridgeton and Camden will lead to acceptable coliform levels in surf clams, so as to reverse the FDA shellfishing ban.

As an aside here, we have in raw sludges as contrasted to thoroughly digested sludge, you may have three orders of magnitude higher coliform levels in the sludge, that is raw sludge may have 500 to 1,000 times the amount coliforms. So even though they may put in 10 percent of raw sludge, these may be the predominating factors in the findings that led to this 6-mile diameter shellfishing ban.

(4) *Dissolved Oxygen Measurements*. DO measurements of bottom, middle, and surface waters at various stations were made each month by the Winkler technique. DO levels were 10 p.p.m. or higher on all samples. There is no evidence of an oxygen sag, and except for one case at station 12 where bottom water was 10 p.p.m. and surface water 11 p.p.m., the values were the same throughout the column.

(5) *Ballasted Surface Drifters*. Figure 6 shows surface drifters and seabed drifters ready to be set out. Only three findings have been reported as of March 26 from 144 surface-drift bottles set out, 48 each month at various stations. This is a very low recovery rate and suggests that integrated surface currents are not strongly shore-directed in this season.

(6) *Seabed Drifters*. Figure 6 shows Franklin Institute scientist Charles Davey setting out seabed drifters. These are held together with salt spools which dissolve. They move along the bottom to show integrated bottom currents.

⁸ H. F. Ludwig and P. N. Storrs, "Effects of waste disposal into marine waters," *Water Research* 4, 409 (1970).

⁹ Ralph W. Buelow, "Ocean disposal of waste materials," *Transactions, National Symposium on Ocean Sciences & Engineering of the Atlantic Shelf*, Mar. 19-20, 1968, Philadelphia; Delaware Valley Section, Marine Technology Society, p. 311 (1968).



FIGURE 6.—Seabed drifters ready to be released by C. T. Davey, FURL scientist, in the sludge disposal area ; two weighted surface-drift bottles are on the bench.

Two hundred and eighty seabed drifters, Woodhead and Davey designs, were set out at various stations with 100 in January, 80 in February, and 100 in March. Of the January 100, 27 have been recovered over a 25-mile stretch of shoreline from Avalon to Villas, N.J., and median drift time was about 23 days. Of the February 80, only three have been recovered, one at Broadkill Beach, Del., and two at Cape Henlopen. No seabed drifters from the third cruise have yet been recovered. The drifters give us information about integrated bottom currents, but do not tell how far individual sludge particles travel before settling to the bottom. Locational and seasonal effects on recovery are an important part of our study.

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(7) *Heavy Metal Analysis.* Analyses of sediments and overlying water have been made by means of atomic absorption spectrophotometry. Results to date with cadmium, chromium, copper, nickel, lead, zinc, and manganese indicate that very low levels are present. The concentrations are generally less than in comparison samples of Delaware Bay muds. Some range comparisons of the New York sludge grounds are possible with three elements. (See footnote 3.)

	Pb (p.p.m.)	Cu (p.p.m.)	Cr (p.p.m.)
New York (within 2.5 nautical miles of center).....	30-151	12-58	12-38
Philadelphia (stations 1, 4, 5, 7, 12, 13; January and February).....	0.01-0.08	0.002-0.57	0.01-0.50

For the New York thing with lead, let's look at lead first: 30 to 151 parts per million in New York. This is within $2\frac{1}{2}$ nautical miles of their center. And with six of our stations the range was from 0.01 to 0.08 parts per million. So we are in some case as much as one-thousandth as the amount of lead that is found in the New York sediment.

Copper, New York had 12 to 58 parts per million; our site 0.002 to 0.57 parts per million.

Chromium, 12 to 38 for New York; 0.01 to 0.50 for Philadelphia, a very significant difference.

(8) *Current Meter Studies.* Short-term measurements of current speed and direction have been made with a Savonius-type recording meter for bottom, middle, and surface water at the various stations. Speeds have ranged from 0.1 to 0.68 knot, mostly in a northerly direction. At 0.3 knot the water volume flowing through the rectangular disposal site in a year is about 400,000 times the volume of sludge deposited there in the same time. The amount of naturally occurring suspended solids, and this is not dissolved solids but suspended solids of both inorganic and organic particulate matter, in that ocean water is approximately 200 times the amount added in the Philadelphia digested sludge.

(9) *Miscellaneous Studies.* These include such things as temperatures, turbidity, compositions of suspended materials, and salinities.

(10) *Pathogen Studies.* Thomas Jefferson University, Department of Microbiology, has undertaken an extensive study of the microbiologic aspects of the samples obtained in the area under study. Included will be a search for bacterial pathogens, such as Salmonella and Shigella, intestinal parasites of man, and enteroviruses of human origin, such as polioviruses, echoviruses and coxsackie viruses. Samples will include animal specimens, interstitial water and sediments from various stations, plus appropriate comparison samples. This study in a number of aspects, particularly in the virus investigation, will be a pioneering study.

An immediate conclusion of our results to date is that the oft-repeated story of the huge sludge blanket and "dead sea" off Cape May is a myth. It is the product of overworked and underinformed imaginations.

The ocean is a great resource for recycling wastes. This is a job it has done well for eons—and with the wastes of a greater biomass than that of the entire human race. We must not deny man the proper use of this much-needed resource; and there are ways to use the ocean for disposal of certain wastes without polluting it in any way. Some who most need to use this resource themselves are suggesting blanket denials of ocean disposal.

Figure 7 shows the estuarine areas behind the Cape May County shore communities condemned for shellfishing for clams, oysters, and mussels. Why? Because of discharge of sewage effluent into the bays. It is important to note that 1 week ago Richard J. Sullivan, New Jersey's commissioner of the Department of Environmental Protection, after a 4-month study, designated ocean outfall pipelines as the best solution for this resort area's disposal needs.¹⁰ This could clean up the bays while at the same time adding valuable nutrients to the oceans in a nonpolluting manner.

¹⁰ Per-Otto L. Erichsen, "Cape May Co. advised to put sewage in sea," *The Evening Bulletin* (N.J. Edition), Philadelphia, Pa. (Mar. 18, 1971).

CONDEMNED AREA CHART 9

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION • BUREAU OF SHALLOAN COURSES • DATE 1994, MARSHALL, NEW JERSEY • 00000

8-048
DEC 70

All legends designed for the purpose of providing access to property and/or the discharge of boats and equipment for the harvest of oysters, clams, and mussels.

All oysters, hard yards, boat houses, harbors or other places where docking facilities are provided for boats are condemned for the harvest of oysters, clams and mussels.

WATER CONDEMNED FOR THE HARVEST OF OYSTERS, CLAMS AND MUSSELS

WATER CONDEMNED FOR THE HARVEST OF OYSTERS, CLAMS AND MUSSELS

WATER CONDEMNED FOR THE HARVEST OF OYSTERS, CLAMS AND MUSSELS

Water Condemned for the Harvest of Oysters, Clams, and Mussels. This area is designated for the harvest of oysters, clams, and mussels. The area is bounded by the State of New Jersey and the State of Delaware. The area is bounded by the State of New Jersey and the State of Delaware. The area is bounded by the State of New Jersey and the State of Delaware.

Water Condemned for the Harvest of Oysters, Clams, and Mussels. This area is designated for the harvest of oysters, clams, and mussels. The area is bounded by the State of New Jersey and the State of Delaware. The area is bounded by the State of New Jersey and the State of Delaware. The area is bounded by the State of New Jersey and the State of Delaware.

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"PENALTY FOR TAKING OYSTERS, CLAMS OR MUSSELS FROM CONDEMNED WATERS \$100.00"

FIGURE 7.—Condemned areas for taking oysters, clams, or mussels in estuarine waters adjacent to shore communities in Cape May County, N.J.

The present surf clamming ban in the sludge disposal area, with its associated economic effects does concern us. As the situation improves with the cessation of raw sludge dumping, perhaps FDA will reconsider the extent of its ban. For example, might a 3- or 4-mile radius be preferable to a 6-mile radius—or might conditional shellfishing be permitted for cooked products, which, as you know, these clams are used in chowders and are basically cooked products, and the surf clams are cooked products.

In addition, the results of our 12-month program will be used to provide information to Philadelphia in considering possible further improvements in their treatment and disposal practices—including such things as sterilization of the sludge by gamma radiation,¹¹ and relocating the site beyond the 20-fathom line, away from the surf clamming activity.

Finally, I would express our encouragement of similar research activities in this area and our willingness to cooperate with such activities. It is only on the basis of knowledge that real progress and constructive legislation can be obtained.

Thank you.

Senator Boggs. Gentlemen, we thank you for the valuable testimony. You are giving the committee something to do, reconciling your testimony with that of others.

I know that there are many questions. I might say that after the record is made available to the other members of the committee, we may ask you to appear again to discuss your views.

Dr. ERB. I for one would be pleased to testify before the committee at any time.

Senator Boggs. First, this question occurs to me: if you were beginning to select a dump site now, would you go farther out to sea in view of the experience you have had and the knowledge you have had about this site?

Mr. BAXTER. I am the one, of course, who selected it and I guess I probably ought to answer first.

I can't help but know and partly because I manage a large water and waste water facility that has over 500,000 customers, not only do you have to pay some attention to facts and science but you have to recognize some human feelings, even emotions. So if I had known in 1960 when we made the decision that there would be the problems where people are concerned, we probably might have gone farther out, that is correct, but only on that basis because as we look at it now we still think that this is a site that is not causing any trouble to the ocean. And I am going to repeat what I said, and what Doctor Erb has said, that we are putting back material, we are really recycling the same thing you might buy to put on your garden or lawn to help things grow.

So that is the answer, Senator.

Senator Boggs. Thank you.

Doctor Erb, I noticed clams on the slides you showed. Do your studies go into the bacteriological effect on the clams in this dumping area?

Dr. ERB. As a matter of fact we are looking at the possible pathological effects on the ocean species, on the macrofauna, as we use the

¹¹ "Nuclear sewage treatment plant becomes operational," *Environmental Science & Technology* 5, No. 3, 197 (1971).

term, and we have cooperation from a biology professor and student from Lehigh University, Robert Mandle, who is running just these kind of studies. Now, they did look at the fishes that we did pick up, for example, look for evidence of fin rot which is one thing, particularly in the New York area, associated with the sludge dumping site, and there were no pathological evidences on any of the species that they found, including those Astarte clams that we brought up. Everything looked healthy.

Senator Boggs. Everything looked healthy, you said. But did you test for heavy metals or pesticides or other toxic substances in the organism?

Dr. ERB. We are going to do this. What we need is a larger collection sample to run the heavy metal analyses, but we are going to get heavier collection equipment so that we can run this with atomic absorption spectrophotometry on the clams and other species themselves. In fact, we did chop up some starfish the last time.

Senator Boggs. There really needs to be more study.

Dr. ERB. That is right, and we are going to be doing collections, by the way, with scuba equipment in the summertime so we will be able to get a variety.

Senator Boggs. What is the depth out there?

Dr. ERB. The depth ranges from 42 feet to 70 feet in the area. The average is about 60 feet, a little over 60 feet.

Senator Boggs. Is the ocean bottom fairly level, or is it hilly?

Dr. ERB. It is fairly level, as you would say on land. In the ocean you can see the contours fairly close together but it is level as you would look at it by land.

Senator Boggs. But before the dumping started, it was a productive fishing area, was it not?

Dr. ERB. That is right, and it is within the area as found on surf clamming maps.

Senator Boggs. And it is now closed?

Dr. ERB. It is off limits now.

Senator Boggs. Let me ask Mr. Baxter a question. How do you check on short dumping? Is there a penalty in your contract for short dumping, and how do you check on this?

Mr. BAXTER. First of all there is a penalty in the contract. Secondly, from time to time we have sent out our own men, in this case surveyors who are able to check where it may be. We also check the logs of the captains and depend somewhat on the fact that any master of a vessel that showed in his log something that is not true can actually lose his license. We have used all of those things and I know this, within the last several weeks because some people in Delaware were concerned, we now notify the State of Delaware department each time a vessel goes out so they can look at it.

Senator Boggs. You have mentioned that digested sewage sludge does not have an adverse effect on the marine environment. Yet this morning we heard Mr. Sullivan say that sludges are contaminated with toxic materials—heavy metals and so forth. What steps, if any, does Philadelphia take to remove these materials from sludge? Did you cover that in your testimony?

Mr. BAXTER. No, I don't think I covered it as such but some of those are the ones that come through our regular sewage process, and

you remember I mentioned that we have industrial waste that comes into our regular plants but I would think if there was any toxic results from any of the metals that were in it that we wouldn't even have been able to digest the sludge. Our digestion process would fail and we have not found that, our digestion process still works which is an indication that these metals are not toxic.

Senator BOGGS. Have you contemplated or considered research into removal of these metals from the sludge?

Mr. BAXTER. I presume that in this field we consider or discuss all sorts of things. I would think that such a thing as that when we are talking about absolutely removing all of these things, this is not anything that would be anywhere near economic, but wherever there is any problem of toxic metals coming into our sewage process we do require the industrial people to remove those things. As an example, in wastes from a plating plant, we make those people take those metals out before we get it.

Senator BOGGS. Digestion would not degrade lead or mercury or other metals?

Mr. BAXTER. No. There are many metals in it; yes. But I still point out that all of these things do get returned to the environment in some way.

Senator BOGGS. Senator Beall?

Senator BEALL. Thank you, Mr. Chairman.

On the matter of the digested sludge, I don't have a very scientific mind; is there any evidence of what happens to digested sludge after it has been exposed to the ocean seawater for any length of time, does it become undigested by any chance?

Mr. BAXTER. I can answer that one; no.

Senator BEALL. You can answer that part, but there has been no study as to what happens to digested sludge after it has been in the ocean for any period of time?

Mr. BAXTER. Well, except this, that the studies that the Franklin Institute are doing for us indicate that there is no oxygen demand which would be one way which, if it were possible, for digested sludge to go back again; there would be an oxygen demand and it would show a lowering of the oxygen level and that did not show up.

Do you have any comment on that?

Dr. ERB. I have some comment on that.

The particulate matter here that you have is both organic and inorganic, as he said, it is about half equivalent to clay and sand particles and this material, of course, becomes part of the basic ocean floor. It is the same type of material that is already there.

The organic materials hopefully enter the nutrient cycle and become—people talk about using this for fertilizing land, this is used for fertilizing the sea. In fact, if all the organic particulate material was taken out of the oceans, the oceans would, indeed, be sterile and this is one of the reasons, by the way, that fish production is high on the Continental Shelf and low out in the open ocean because the Continental Shelf has the beneficial particulate matter in it, whereas, the open oceans—blue, clear through they are—don't have these substrates which are used to adsorb and concentrate nutrients.

Senator BEALL. Doctor Erb, you made some reference in your testimony the trip that a group took and the articles in the newspapers

resulting therefrom, and I have one of those articles in front of me and I noted there is a conflict in the evidence dug up, shall we say.

Dr. ERB. Dug up; yes.

Senator BEALL. This Washington Star article indicates they went out 14 miles in the ocean, and you and others seem to agree that it is 14 miles generally where the dumping area is taking place. Apparently the captain went to the dumping area and on the third swipe he dug up a 200-pound shovel full of contaminated-looking sludge—if you can judge from the looks—and it had a lot of dead shellfish in it. Now, what do you think would be the cause of this if it isn't the dumping that takes place there?

Dr. ERB. We have tried to get in contact with the people to find out what their coordinates are because we would like to go down and find the same area, so if anyone has the loran coordinates of that area we would appreciate them giving them to us so that our next trip out we can dig in the same area and maybe get some of the answer to this.

As I said previously, though, there are a number of areas and there are some in Delaware Bay, off Delaware Bay and also on the edge of the shelf which have black oozing material; this hydrogen sulfide is merely the indicator of anaerobic conditions and oxygen sag and this does not correspond with what we found at our Station 13 which is the center of the dump area. So I just can't really answer your question.

Senator BEALL. In the FDA testimony on page 6, I would like to quote, it says:

"In addition, bottom water analysis indicated that positive coliform counts were randomly dispersed through the entire closed area."

Your testimony that there are no coliform count was negative in all tests that you conducted. How do you account for this: Apparently these are both scientific, both testings on a scientific basis, how would you account for this conflict if you were making a judgment on which side would you come down?

Dr. ERB. These match perfectly, believe it or not. We have seen some of the figures though we have not been able to get Captain Verber's data, original data points, you know, by station, so we can fit them in with out present stations; but, when he says randomly, that term "randomly" in there can mean, and from what I have seen so far, is that nine out of 10 of his samples may be negative in coliform or below their minimum count, less than two mpn for hundred millimeters, and we may find one that is.

Now, one of the things in open ocean that is the controlling factor is how close do you run your sampling ship in behind the barge, you see. As I pointed out, the time to kill 90 percent of these coliform is 1 to 6 hours. In 1 day then they are essentially all gone. In the open ocean water, 1 or 2 or 3 days, so effects like ours would probably be seen, but if you got close to the barge you might find some coliform in the water.

Senator BEALL. Are you suggesting then that he was close to the barge?

Dr. ERB. I know in at least one of their trips that they were, I mean that they mentioned that they were following, you know, they were looking where the barge was going and things like this.

Senator BEALL. Well, does the fact that we made this finding at all even in random samples concern you, and as a matter of fact arouse a certain amount of fear and at the minimum show the need for further investigation?

Dr. ERB. I am sure there would be and there is an emotional reaction from a number of people.

Senator BEALL. Shouldn't there be a scientific reaction, also?

Dr. ERB. Well, we ask ourselves what effects are these coliforms going to be having and again, apart from the shellfish, there aren't any.

Senator BEALL. It would seem to me then that really the only way to determine if the FDA is correct or not correct is to move on to the coliform test of the shellfish itself. Is that a fair assumption for me to make? In other words, they are saying that the area is contaminated and the only way you could prove that it wasn't would be to conduct those type tests on the sea life that is there rather than just the water?

Dr. ERB. This is right. If they just take random samples, so called, perhaps something like—well, if Captain Stocker's boat was out there and somebody flushed the toilet you could get a random sample with high coliform count.

Senator BEALL. Could that cause a bunch of dead clams?

Dr. ERB. The dead clam issue is something a little different there.

I am just saying you could get the coliform count in the water column. Now, the other thing that relates to the claims in the sediment is entirely a different situation and I would tend to—I would like to reserve judgment on the final cause of this until Bridgeton and Camden stop raw sludge dumping. I don't think it is from the Philadelphia sludge. This is my personal opinion based on what I have seen so far, but I would like to find out.

Senator BEALL. But you agree it is there?

Dr. ERB. I agree what is there?

Senator BEALL. Whatever you said wasn't coming from the Philadelphia sludge. (Laughter.)

Dr. ERB. I am talking about high coliform levels in the sediment and in the clams themselves, this is the problem, and the standards for shellfish waters are 70 mpn, that is most probable number per 100 milliliters, in the water column. That is one of the standards, and the water out there is, by our count, and if you got him down to quantitative breakdown I think you would find in his count, too, essentially zero. It is good shellfish water, but there is the problem of the sediment, there are high counts in the interstitial waters in the sediment, there are high counts in the claims in some areas, and we are going to be getting these data later in our program.

Senator BEALL. But, Doctor, what bothers me, it doesn't make any difference whether the water eventually becomes clean, the fact that it has been dirty for 6 hours means that some damage has been done to the sea life there and something is causing that and although the water itself gets cleaned up maybe whatever life is there doesn't get cleaned up; the contamination on the food chain begins; am I drawing a proper conclusion?

Dr. ERB. No; you are not drawing a proper conclusion.

Senator BEALL. I am not?

Dr. ERB. No, sir.

Senator BEALL. Well, I don't want to take the committee's time—

Dr. ERB. The sea water is sterilizing the bacterial content.

Senator BEALL. It is sterilizing itself?

Dr. ERB. That is right.

Senator BEALL. But what happens in the 6 hours before it becomes sterilized to the life that exists in the sea.

Dr. ERB. Perhaps maybe one of the problems is not putting this in the right perspective. The waters all around us are filled with high coliform bacteria, even when there is no human habitation. I refer you to this month's "Journal of the Water Pollution Control Federation" where they made some studies in what we would call wilderness areas and bayous and other wilderness areas, and they found high coliform levels in the water there in spite of the fact that there was no possible chance of human intervention. The entire Delaware estuary has coliform; all the bays behind Rehoboth Beach and Wildwood have coliform bacteria, many tens of times higher than what we have even right after our barge goes by out in the ocean and I think that we should have the same kind of concern for these as we are putting on the ocean.

Senator BEALL. Well, are you talking about the areas that you showed us on the map where there is no take of shellfish.

Dr. ERB. Those areas and others.

Senator BEALL. They have a high coliform count?

Dr. ERB. Yes.

Senator BEALL. Well, I don't think anybody argues that. But the question here now, is that we have a contaminated area in the ocean, a situation that we don't believe should exist anywhere, we don't want it to exist in the inland waters, but it does, and we hope it doesn't get to the same degree of density out in the ocean. Now, the problem I have is that apparently the situation is beginning to take on the characteristics that have made the inland waters bad; am I drawing a wrong conclusion here?

Dr. ERB. No, that is not true. The water mass there has reached steady-state and is at a steady-state level and it is essentially zero coliform level in the ocean water. What happens in the local sediments is the other problem and we can talk about that, too, but let's not say that the ocean's water, or the body of water is coming up to high coliform levels. That is simply not true.

Senator BEALL. Then why has the FDA closed the areas and why are there dead shellfish in the area?

Dr. ERB. They have closed the area because they have gotten high coliform counts in some shellfish and they mention a 3 mile swath across this 6 mile area. I say, true, we don't disagree with this and we are going to be able to reproduce the results. We don't have the data back yet. As you know this is a fairly young program, but we feel that this will definitely improve with the cessation of raw sludge dumping.

Mr. BAXTER. I think, Senator Beall, this is an important thing; this raw sludge going out in the ocean, and we know first of all we produce raw sludge in the plant before it is digested and, it was in my testimony that it has a very high coliform count. And we have been

having the Bridgeton and Camden sludge, and perhaps some others that we don't know about.

Senator BEALL. Thank you, Mr. Chairman.

Senator BOGGS. Thank you, Senator Beall.

Commissioner Baxter and Doctor Erb, in view of the time, I am going to ask you to answer in writing some questions which we have prepared. Your answers for the record would be helpful to the committee to gain a further understanding of your testimony.

Mr. BAXTER. And remember also that we are still working on this, we will be working on this contract for the rest of this year.

Senator BEALL. Mr. Chairman, in addition, for my own edification and as well as the edification of the rest of the members of the committee, I would like the FDA and EPA comments on this testimony here. Maybe we can get some clarification.

Senator BOGGS. The committee will do that.

I would like to ask one concluding question. Will you comment on the need for a permit system to control ocean dumping under, for example, the Environmental Protection Agency?

Mr. BAXTER. First of all, I recognize this is a hearing on this particular problem and you haven't made us feel like defendants. I did not in my testimony comment on any of the bills. I would like to comment on those and send it along after I have read them again.

Senator BOGGS. Very good.

Mr. BAXTER. I would certainly have no objection, I can also say I would like to approve some type of legislation, some type of control over this problem. I think we might not have had this problem, as an example, if everybody had been sending digested sludge out to this area, and in some of the others so-called, or in the New York so-called, dead area. So on that basis we think we would be protected by proper reasonable legislation.

I would certainly like that it be based again on the kind of studies that we are making and I repeat again, what I said: if we are harming anything there as we show it, we will get out of there whether we go a hundred miles out or whether we incinerate, before anybody tells us.

Senator BOGGS. Thank you very much. We appreciate your testimony and we will submit these questions to you.

(Subsequent to the hearing the following questions and answers were developed:)

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
Washington, D.C., April 13, 1971.

Dr. ROBERT A. ERB,
Principal Scientist, Chemistry Department, Franklin Institute Research Laboratories, Philadelphia, Pa.

DEAR DR. ERB: On behalf of the Subcommittee on Air and Water Pollution, I wish to thank you for your useful contribution to our hearing on ocean dumping at Rehoboth Beach, Delaware.

In order to complete the hearing record, certain additional information would be helpful to clarify points made during testimony. Would you kindly supply us with written replies to the questions listed below at your earliest convenience?

Thank you for your cooperation.

Sincerely,

EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution.

CITY OF PHILADELPHIA,
WATER DEPARTMENT,
Philadelphia, Pa., April 8, 1971.

MR. LEON C. BILLINGS,
Subcommittee on Air and Water,
Public Works Committee,
U.S. Senate, Washington, D.C.

DEAR MR. BILLINGS: At the hearing of the Subcommittee at Rehoboth Beach, Delaware, on March 26, 1971, Dr. Erb of Franklin Institute and I were given a series of written questions to answer.

I am enclosing a copy in duplicate of answers made by both Dr. Erb and me to these questions. Each of us has answered them within the sphere of our own competence and knowledge.

Sincerely yours,

SAMUEL S. BAXTER,
Water Commissioner.

(Questions sent with Senator Muskie's letter are included with answers received by Dr. Erb and Mr. Baxter.)

QUESTION 1. *You mention finding apparently healthy marine organisms in your sample. Are you attempting to trace changes in the numbers of such organisms?*

ANSWER 1. We do not know of any definitive baseline studies in this area which we could use for tracing changes in numbers of organisms. We will, of course, keep records of our finds for each location throughout the year; however, normal annual variations in marine populations would prevent significant conclusions about long term trends from being obtained in just one year. Concerning reported decreases in the ocean of a number of food species, both finfish and shellfish, the weight of evidence shows, that, by far, the principal cause is *overfishing*. (With a modern clamming vessel that can take up to 70 tons/day of surf clams, how long will it be before depletion of a region occurs?) A secondary cause in some cases is *estuarine* pollution. The estuaries are the areas for spawning and nursery stages, the more sensitive stages, for about 85% of the food species eaten in the United States. Nowhere, and I repeat *nowhere*, have I seen pollution of the ocean itself clearly demonstrated or documented to be the cause of general depletion of any finfish or shellfish species.

QUESTION 2. *Did you fail to find any species in the study region which you would normally expect to find in uncontaminated waters in this area?*

ANSWER 2. In terms of the degree of sampling done so far, I would say no. At this writing, in addition to organisms mentioned in the testimony, we have found lively and apparently healthy horseshoe crabs, conchs star coral, surf clams, and mackerel.

QUESTION 3. *You have noted that analyses of seawater and bottom sediments show safe levels of heavy metals. With the known potential for biological concentration of such elements to toxic levels by living organisms, can any conclusions be drawn from your present data about the hazards of heavy metals to organisms in the dumping area?*

ANSWER 3. On the basis of our present data I would say that there appear to be no hazards due to heavy metals to any organisms in the dumping area. We are well aware of the potentials for biological concentration and are extending the measurements of heavy metal concentrations to a number of benthic organisms inside the disposal area, with specimens taken outside the area for comparison.

QUESTION 4. *It was suggested by several testifiers during the hearing that disposal of nutrient rich wastes into the oceans could produce a beneficial fertilizing effect. What is the potential for undesirable effects of eutrophication resulting from such a policy in the long run?*

ANSWER 4. Nil. This can be shown from mathematical considerations of the water-mass movements, the nutrients and particulate matter naturally present in sea water and the nutrients added by digested-sludge disposal.

QUESTION 5. *Are there plans to measure the level of pesticides and polychlorinated biphenyls in organisms in the dumping area? If so, will such tests include organisms representative of all levels of the food chain, from plankton to predatory birds?*

ANSWER 5. No. A much higher level of funding would be needed to provide for a definitive program of measurement of pesticides and polychlorinated biphenyls (POBs) with organisms throughout various food chains and in several locations. Techniques for analysis, such as microcoulometric gas chromatography, generally require complex multistep procedures. This might be a suitable area for federal research funding. One note of caution: Use of PCBs as plasticizers has essentially ceased in this country, and domestic use of DDT and certain other pesticides has also dropped sharply; therefore it may become increasingly difficult to find measurable quantities in organisms as time goes on.

QUESTION 6. *You stated that "the minerals and organics in the sludge would have beneficial effects." Have you analyzed this sludge for toxic substances like pesticides and synthetic organics, which ordinarily are not degraded by bacteria during sewage sludge digestion?*

ANSWER 6. No, but such an activity might fit well within a federally-sponsored research program as mentioned in the previous answer, particularly with respect to refractory pesticides and PCBs. Two comments on the question: (1) Most types of synthetic organic chemicals are degraded by aerobic and/or anaerobic bacterial processes. (2) I don't know of any synthetic organic chemicals which are toxic in the concentrations in which they might be expected to be found in digested sludge; certainly if any in the concentrations present were toxic to anaerobic bacteria the digestion process could not be carried on.

(The following questions were directed to Mr. Baxter or Dr. Erb. The answers were supplied by Dr. Erb:)

Question for Mr. Baxter or Dr. Erb:

You have mentioned that the sludge is 90 percent water suggesting therefore no effects will occur. Yet some ecologists suggest that this is treated FRESH water which has an effect on the marine environment similar to the effect caused by the sludge itself.

Would you or DR. ERB care to comment on the dilution effect of fresh water on the marine environment?

Answer:

Let's assume we are putting in 110×10^6 gallons per year of fresh water into the 3.2 square mile disposal area: this is added to about 46×10^{12} gallons of water per year in the sea water naturally flowing through the same area. This represents an addition of one part of water for every 420,000 parts already there. In other words the dilution effect is essentially nil. (In an average year the Delaware River itself adds about 340,000 times the volume of water to the ocean compared with that added in the Philadelphia sludge.)

Questions for Dr. Erb:

Both Mr. Coulter and Mr. Baxter have suggested the potential that disposal may produce beneficial effects.

Would you comment on the possibility of producing a situation similar to the eutrophication of fresh waters?

Answer:

Eutrophication, the process of enrichment with nutrients, is in a problem form associated with excess nutrients in a water body and excessive growth of algae, leading to lowered dissolved oxygen levels; it is a particular concern in the premature aging of lakes. The conditions for harmful eutrophication, however, do not exist in the ocean environment in question. The ocean waters are under-fertilized, and large masses of highly oxygenated water pass the site each year (the water in the volume element at the rectangular site is completely changed about 1200 times each year based on a typical current speed of 0.3 knot).

Question:

What about the potential concentrations of materials by biological organisms, which you did not discuss in your statement?

Answer:

Biological organisms do concentrate certain materials, such as heavy-metal ions, from both natural and altered environments. We are studying this experimentally in our program by direct measurements of metal concentrations in sediments and in benthic organisms. The following table shows some of our most recent measurements (trace metals in ppm; for sediments, extraction with 1 part concentrated hydrochloric acid per 100 parts sample, 1 hour at 250°F):

	Cd	Cr	Cu	Pb	Mn	Ni	Zn
Starfish (station 13).....	0.14	0.1	3.39	0.06	0.18	0.2	6.35
Moon Snail (station 13).....	.28	0	.10	.06	.13	0	.48
Sediment (station 13).....	.11	0	.12	.40	1.13	0	.56
Control sediment (southeast, beyond 6-mile radius).....	.32	0	.06	.05	.76	0	.38

As can be seen, not all heavy-metal elements (e.g., Pb and Mn) appear to be present more in the organisms than in the sediments. In other cases the ratio is very low. It should be noted, too, that concentrations of certain heavy metals in the sediments at the disposal site are within the range of metal concentrations in control samples well outside the area. We plan to develop a full picture in the next few months through systematic measurements of metal concentrations in surf clams and other organisms, as well as in sediments and sea water at many locations in this area of the ocean.

Question: Studies have indicated greater concentrations of toxic metals at sewage sludge disposal sites than exist in other areas of the ocean floor. Is that confirmed by your work, and would you agree that such concentrations are detrimental to the environment?

Answer: While this is true in the New York raw sludge area, we have not found evidence of detrimental concentrations of metals in the Philadelphia disposal area. Indeed, we often have found lower concentrations of heavy metals in the sediments in the disposal region than outside the 6-mile radius toward the bay or toward the open ocean.

Question: What is your view on the use of junked cars or old tires for the building of artificial reefs in the ocean for the protection and enhancement of sea life? Is this a threat in any way to the environment?

Answer: My view (we have made studies on this at FTRL) is that construction of artificial reefs using junked cars, old tires, or other suitable wastes can be very beneficial for increasing the local fish populations for sportfishing activities. This represents an example of how wastes, rather than being a threat to the ocean environment, can be beneficial to it.

Question: The Franklin Institute, I understand, has studied the feasibility of constructing a pipeline reaching far out into the ocean that would carry wastes for disposal purposes. Could you tell us something about this project, its costs, its effectiveness, and the potential environmental impact?

Answer: This project, which has been investigated at The Franklin Institute over the past four years, is a feasibility study of a regional system for disposal of waterborne solid waste concentrates (80% dredge spoil, 10% digested sewage sludge, and 10% selected industrial wastes) by pipeline to the upper continental slope region, about 85 miles from shore and a depth of about 1200 ft. The cost of such a system for the Delaware River Basin is estimated to be close to \$100,000,000. We have studied the upper continental slope area by various means including three research cruises on the RV Dolphin and a 26-hour dive in the Ben Franklin submersible, covering about 8 miles along the bottom to depth up to 1800 ft. Favorable indications relating to environmental impact include: current patterns consistently away from shore; high dissolved oxygen levels combined with movement of large water masses; and low biomass compared with the near-shore shelf (about one-fifteenth), with a small fraction of this being food species. This program of studying the upper slope region is presently suspended because of the lack of availability of funds from EPA, Water Quality Office. However, I believe that very extensive further studies should be carried on, particularly in view of interest in disposal beyond the shelf break shown in this Hearing.

Question: What kind of criteria should be used in selecting offshore dumping sites? Aside from the distance from land and the depth of the water, are there any other criteria that should be considered in selecting dump site? Could you give us some examples?

Answer: Criteria should include not only distance from shore (which has economic as well as environmental aspects) and depth, but also such things as bottom current speeds and directions, dissolved oxygen levels (which with currents bear on the possibility of oxygen sag), temperature-depth profiles, and life-forms present (with particular emphasis on benthic infauna and epifauna, and food species in the regions). All of these and more are being studied in our present program.

Question: What is the status of the plan by Philadelphia to dispose at sea the wastes stored at the Revere Chemical Company plant?

Answer: Mr. Baxter has stated that the disposal of wastes from the Revere Chemical Plant is not the responsibility of the City of Philadelphia. I would note further, however, that storage on land of certain wastes which have leachates which are toxic when in high concentration can lead and has led to contamination of ground water, which is present in relatively small volumes as compared with ocean water masses moving by a given site.

Question: Could you describe for us exactly what the ocean floor looks like in the vicinity of the sewage sludge dump area?

Answer: As I stated in my oral testimony, and showed in Figure 3 of my written testimony, the bottom samples in the vicinity of Station 13 (the center of the sludge dumping area) consist of clean sand, gravel, and shell fragments. We have stored bottom grab samples in a frozen state from the three trips to date; these are available for inspection at The Franklin Institute by any interested parties.

Question: Do you believe ocean dumping should be limited to areas beyond the Continental Shelf? Why?

Answer: I do not believe that there should be a blanket limitation of ocean disposal to beyond the edge of the Continental Shelf. There appear to be certain cases in which beneficiation of the shelf waters can take place by controlled disposal of selected wastes. Government support of research on beneficiation of the oceans with selected wastes should be encouraged, just as much research has been supported which is aimed toward improving land by the addition of wastes.

CITY OF PHILADELPHIA,
WATER DEPARTMENT,
Philadelphia, Pa., April 6, 1971.

Answers to Questions Submitted to Samuel S. Baxter, Commissioner, Philadelphia Water Department at the Hearing of the U.S. Senate Subcommittee on Air and Water Pollution on March 26, 1971.

QUESTION A-1. What is Philadelphia's per-ton cost for barging sewage sludge to this dump site? What alternative methods of disposal have you considered? What is the cost of these disposal methods?

ANSWER. Present cost for barging liquid sewage sludge is approximately \$1.00 per ton. The present cost per dry ton of solids is \$9.50. Alternative methods which have been considered are lagooning, incineration, and wet oxidation. Lagoon space is not available, and without making detailed studies at the present time, incineration and wet oxidation procedures would cost at least six times as much as disposal at sea.

These latter methods would contribute to air pollution in urban areas since there are sulphurous and nitrogenous materials present. Particulate matter emission from sacks will also raise problems.

I note that the incineration of sludge would prevent the natural recycling which we believe can be accomplished in the ocean. Man takes things from the ocean including fish for food, and chemical products, and it would seem to be an appropriate form of recycling to return some of these to the ocean environment.

QUESTION A-2. How much does the average Philadelphia family pay for sewer service? Does this cover the city's full costs, or does the city have to use tax revenues to pay part of the cost?

ANSWER. The average Philadelphia family in a small house pays approximately \$30 per year for sewer service. This covers the full cost to the city of operation of the sewer and treatment facilities and the amortization of debt. Those services are required by law to be self-supporting and there are no city tax revenues involved in this work.

QUESTION A-3. If Philadelphia used a more expensive disposal method for its sewage sludge, what would be the annual cost to the city? What would be the cost per family if this cost were passed along in higher sewage rates?

ANSWER. Capital costs and operation costs would substantially increase if some form of incineration is used. It is estimated that these increases would result at least in a 10% addition to the present sewer bill for the average family in a small house. It is pointed out, however, that the city is under order to in-

crease the treatment level at all of its pollution control plants within 6 years, and that this will result in about a 50% addition to the present service charges without allowance for inflation.

QUESTION A-4. *What would be the effect of a six-month moratorium on any ocean dumping, as proposed in S. 1286, while EPA was developing a permit system to prevent degradation of the ocean?*

ANSWER. The effect of such a moratorium would be disastrous since there is no way to stop the production of sewage sludge. It must be disposed of in some manner. Financing, design and construction of incineration facilities would take at least 3 years.

As indicated in the testimony of Dr. Erb, there is no basis for a panic-derived move of this sort. No benefit and much harm would result and I know of no practical 6 months moratorium.

QUESTION A-5. *I understand that a company known as Ocean Environmental Engineering has suggested that it can barge wastes 100 miles to sea for disposal at the same cost Philadelphia is now paying to barge wastes 12 miles to sea. Are you familiar with that suggestion, and would you tell us if it is economically feasible for Philadelphia?*

ANSWER. Representatives of the Ocean Environmental Engineering Company have talked to me previously and suggested that this company can barge waste 100 miles at the same cost which we are now paying for hauling to the present location. None of us in the Philadelphia Water Department have been able to understand the several calls which we have received, but we do know that the president of the company has been active and has attended meetings of the "SODA" group in New Jersey.

Our present contract for this work covers a 3-year period and the first year under the contract will end on June 30 of this year. There was some indication by the president of the company that if we cancelled the present contract he could haul the sludge a longer distance at the same cost.

It was pointed out that the present contract was awarded after competitive bids. Under normal circumstances it does not seem to me that we could double the hauling distance and still get the work done at the same price.

Before we would want to move to another site we would want to make studies to know that the site would be a good one in terms of currents, patterns, bottom conditions, and life forms which are present.

QUESTION B-1. *Could you tell us what the other 13 disposal methods were that you mention on Page 3? What were their disposal cost per 1,000 gallons? Could you summarize the environmental impact of each of the other disposal methods?*

ANSWER. The alternative methods of disposal were considered in 1958. A full description of the study was presented at a meeting of the American Society of Civil Engineers in that year and published in the Journal of the Sanitary Engineering Division of the Society in November, 1959. The paper includes a tabulation showing the cost of various alternates. They are compared on the basis of the cost of dry solids, which is the proper way for comparison. A copy of the paper is attached.

The environmental aspects of alternate methods have been discussed in the formal testimony and in other answers. Simply stated, lagooning is not practical due to the absence of land, and incineration poses problems of air pollution and the need to find a land area for the disposal of the residual solids.

QUESTION B-2. *You discuss the use of digested sludge for improving agricultural land. What effort has the City of Philadelphia made to find an agricultural buyer for your sludge?*

ANSWER. From time to time we have reviewed the possibility of the use of sludge on agricultural land. None of this has been available near the Philadelphia area.

Many people have visited our Northeast Plant to discuss the possibility of using our sludge. After full investigation, none of them have been willing to use it.

In order for the sludge to be used for agricultural purposes, it must be dried and sterilized and this adds considerably to the cost.

It is interesting to note that this question indicates that sludge can be used for fertilizing land, but a great deal of the testimony at the hearing objected to the use of this same sludge for fertilizing the ocean bed.

QUESTION B-3. *Could you tell us in some detail why the present dumping site was selected?*

ANSWER. The present dumping site was selected after discussion with responsible and experienced people in the District Office of the Corps of Engineers. It was chosen as a place where there would be a minimal chance of any material getting back to the coastal beaches. There was no indication at that time that the area selected was a high grade shellfish area let alone a much lower grade area which it is. The principal point which was considered was that we believed that there would be no harm in depositing sludge at this particular location.

QUESTION B-4. *How closely does the city monitor the dumping to assure that it will take place 11½ miles offshore, not 4 miles, or 7 miles offshore? Would you have any information on the percentage of sludge that is dumped off the target?*

ANSWER. From time to time the Water Department has sent surveyors with the tug and barge to make sure that the sludge was not deposited too close inshore. We know that other people have checked the disposal area from time to time. We depend greatly upon the log kept by the tug boat Captain, since any false entries should subject him to loss of license.

In addition, the specifications provide and the contractor knows that if he does not deposit the sludge in the right area he will not be paid for the particular trip and the payment approximates \$3,000 each trip. We have one recorded instance in 10 years where there was indication that the barge was unloaded in the ocean, but not at the designated site. Despite the contractor's denial of fault, he was not paid for this load.

From time to time, people have said that disposal was not made at the designated area, but proof has never been given and we have not been able to substantiate these statements. We point out that other communities and organizations also deposit material in the ocean.

Within the last few weeks and at the request of the State of Delaware, we have notified them of the time of departure of each barge load in order that they may make whatever check they desire.

QUESTION C-1. *You suggest that digested sludge does not have an adverse effect on the marine environment. Yet this morning Mr. Sullivan said that all sludge is contaminated with toxic materials like heavy metals. What steps does Philadelphia take to remove these materials from their sludge?*

ANSWER. We know of no practical way to remove the very small concentration of heavy metals for the volume of sludge which we handle. The Philadelphia Water Department has an industrial waste unit which visits all commercial and industrial establishments in the city and encourages procedures to remove excessive quantities of heavy metals from industrial wastes before they are discharged into the sewer system. We believe that we have made considerable progress in this work, and especially so where it can be pointed out to the industries that it is economically desirable for them to salvage these metals.

QUESTION C-2. *What consideration was given to metals, for example, when evaluating the effects of your current practices?*

ANSWER. Dr. Erb has testified to the results which we have obtained so far in evaluating the effect of heavy metals in the disposal area. These decisions indicated to us that excessive levels are not resulting in the ocean sediments as a result of our disposal practice.

QUESTION C-3. *Have you analyzed this sludge for toxic substances like mercury, cadmium and lead, or pesticides and synthetic organics, which reportedly are not degraded by bacteria during sewage sludge digestion?*

ANSWER. Dr. Erb's studies have already covered 6 heavy metals and others including mercury are being added to our study. It is noted that the testimony on metal content of sludge by Dr. Heller came from data supplied by the Philadelphia Water Department.

We are concerned that in several places in the testimony of persons at the hearing that the word "toxic" was prefixed to the term heavy metals. Heavy metals do occur in various concentrations in drinking water, medicines, and household items and are excreted by the human body and it is natural to find some of them in the sludge which results from treatment.

In preparing an answer to this question I have obtained the following information from Deputy Commissioner Guarino of the Water Department, who is both a chemist and a civil engineer. He says this—"The determination of the quantity

of heavy metals involves special analytical technique. The method used in Philadelphia basically involves digesting the sample with hydrochloric acid for an appreciable period of time and in an autoclave at 10-30 psi. The fact that heavy metals are present does not mean that they are in a form that can be used or absorbed by an organism."

I have personally discussed the preliminary work which has been done for us by the Thomas Jefferson University. They are studying both the water in the ocean bed and the aquatic life for bacteria, viruses, and heavy metals. The results of their work to date are negative as far as harmful effects which might be caused by the disposal of our sludge in the presently used area.

I make again the suggestion which was contained in the formal part of my testimony that no hurried decision be made to abandon the present site of disposal for digested sludge until such time that we have completed our studies. These studies do not show harmful effects at this time.

QUESTION F-4. *What is the status of the plan by Philadelphia to dispose at sea the wastes stored at the Revere Chemical Company plant?*

ANSWER.—The disposal of wastes from the Revere Chemical Company is not the responsibility in any way of the City of Philadelphia.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
PUBLIC HEALTH SERVICE,
FOOD AND DRUG ADMINISTRATION,
Rockville, Md., April 9, 1971. -

Hon. EDMUND S. MUSKIE,
Chairman, Subcommittee on Air and Water Pollution, Committee on Public Works, U.S. Senate, Washington, D.C.

DEAR SENATOR MUSKIE: This is in reply to the request for comments from James L. Verber on the testimony of Mr. Samuel S. Baxter and Dr. Robert A. Erb before your Subcommittee hearing on ocean dumping at Rehoboth Beach, Delaware, March 26, 1971.

Comments on Testimony of Mr. Baxter

We note that claims are made as to the effectiveness of treatment of these waster materials. Health officials, however, are guided by known as well as the potential health hazards. There is no evidence to indicate that the digestion process suggested by the City of Philadelphia produces a reliably safe sludge. On the contrary, the research literature indicates that survival of pathogenic contamination and a potential health hazard exists.

Comments on Testimony of Dr. Erb

1. In November 1970, the Northeast Technical Services Unit, Shellfish Sanitation Branch, Food and Drug Administration, found 18 of a total of 119 sediment samples or 16% which showed positive coliforms. These sample stations were distributed randomly over the 6-mile radius of the closed area. During the same survey, 52 bottom water samples were collected within the same area in which 10 samples or 19% showed positive coliforms. Within the sensitivity of the test used, coliform organisms are not normally found in water in the open seas.

2. A sample of the digested sludge from the Philadelphia sewage treatment plant, prior to loading on the barge, showed a total coliform MPN of 7 million and a fecal coliform of 790,000.

3. A review by Kabler (1959) showed that typhoid and tuberculosis organism and tapeworms survived in anerobic digestion. He indicated that 12 to 15 months of drying would be necessary to render *M. tuberculosis* non-viable.

4. McKee and Wolf (1963) in Table 7-1, "Survival Date for Salmonella," showed that typhoid bacilli and other species of salmonella survived in sea water for over 30 days. These works show that potential health hazards can exist in this area.

5. The National Shellfish Sanitation Program requires the establishment of a "Closed Safety Zone" around sewage outfalls and sewage dump sites affecting shellfish growing areas as necessary action for the protection of public health.

References

Kabler, Paul, 1959, Removal of Pathogenic Microorganisms by Sewage Treatment Processes, J. Sew. and Ind. Wastes, Vol. 31, No. 12, pp. 1373-82 Doc.

McKee, J. E. and Wolf, B. W., 1963, Water Quality Criteria, California State Water Quality Control Board, Publication No. 3-A 548 pages.

Thank you for this opportunity to provide these comments for the record. Please let us know if we can be of assistance in any way.

Sincerely yours,

M. J. RYAN,
Director,
Office of Legislative Services.

Senator Boggs. I would like to place in the record a statement, dated March 26, 1971, from the Lewes Chamber of Commerce. It is signed by the president, Robert G. Gibbs, and relates to this problem.

(Statement referred to follows:)

LEWES CHAMBER OF COMMERCE,
Lewes, Del., March 26, 1971.

STATEMENT

To : Senate Subcommittee on Air and Water Pollution.

From : Lewes Chamber of Commerce.

Subject : Off-Shore Dumping.

The business community of Lewes, a city which receives a substantial income from summer visitors and tourists, is concerned with anything which might adversely affect this phase of our economy.

We are not technically competent to evaluate the effects on our waters of off-shore dumping of sewage and industrial wastes.

We can only state that, if in the opinion of experts, this form of waste disposal could present any hazard to our shores, we would be greatly concerned and would hope that prevention or control of this practice could be instituted through appropriate legislation.

Respectfully submitted,

ROBERT G. GIBBS,
President.

Senator Boggs. Our next witness is Col. Carroll Strider, district engineer, U.S. Army Corps of Engineers, Philadelphia. Colonel, we are glad to have you with us today.

STATEMENT OF COL. CARROLL D. STRIDER, DISTRICT ENGINEER, U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA, PA.

Colonel STRIDER. Thank you, sir; glad to be here.

Senator Boggs. Colonel, we have your full statement. You can read it or it will be placed in the record as you gave it, word for word, and then you can summarize it. Proceed as you wish.

Colonel STRIDER. I have brought along with me and I would like to introduce Mr. Carl C. Cable. He is with the operations division of my office in Philadelphia.

Senator Boggs. Glad to have you here, sir.

Mr. CABLE. Thank you, Senator.

Colonel STRIDER. In the interest of time I will summarize, if that is all right, and let my statement go in the record.

Senator Boggs. Your statement will be in the record following your remarks.

Colonel STRIDER. I think maybe the key point from my point of view—first of all, I do represent the U.S. Army Corps of Engineers, Philadelphia district, and I emphasize the Philadelphia district and not the Chief's office speaking.

I would like to relate how the Philadelphia district has participated in the ocean-dumping activities.

We took it upon ourselves, and I say this kind of loosely, because I have only been there 9 weeks; the Philadelphia district took it upon themselves when ocean dumping first started and their records go back to 1961 when Philadelphia first decided they needed to get rid of their sludge by ocean dumping, and, of course, the questions arose where they would dump and how far out and this sort of thing. The Corps of Engineers at that time told them, of course, that we had no responsibility, we have no authority over the waters of the United States other than those navigable waters within the territorial 3-mile limit.

However, in the interest of keeping a record of who dumped what, where, and when, we have had the cooperation of both the municipalities concerned and industry in letting us know the times that they were dumping and what they were dumping. We have maintained these records both by quantities—in my report there are graphical portrayals of these dumpings—along with the locations of the dumping sites.

I would guess that these are the essential key points of the activities that we have done in connection with ocean dumpings.

I would like to say at this point that the municipal concerns and the industrial concerns have been cooperative in giving us this information and have been concerned with the location of where they have dumped; for example, the acids and the arsenics have been dumped at a long distance out in the ocean. Some of them, I guess recent heavy metals went more than 100 miles out, and the ocean is more than a mile deep out in these areas. So they haven't surreptitiously gone above hither and there.

Senator BOGGS. Did the Corps of Engineers make the final decision on the site?

Colonel STRIDER. No, sir; we did not. We had, on occasion, people contact our office requesting this sort of information and we did pass on certain areas that we knew of that had been previously used as dumping sites. For example, there are two or three areas that were used for dumping ammunition during World War II, and rather than scattering things up and down the coast we thought it best to limit it to certain areas.

Senator BOGGS. What control has the Corps of Engineers, set up under the 1889 act covering ocean disposal from the harbors of New York, Baltimore, and Hampton Roads, Va., are you familiar with that?

Colonel STRIDER. I am familiar with this to the point that I know in the New York district and the Baltimore district that the district engineer has also the responsibility as harbor master. Under this he has authority to regulate some of the ocean dumping. Mr. Cable may have more on this than I.

Mr. CABLE. What they did, Senator—they have a system of permitting the transport of the materials out of the harbor—such transportation is not covered under the laws which we have to operate under.

Senator BOGGS. Thank you, sir.

Are you saying, Colonel, that the corps was not the agency that selected the present dumping site?

Colonel STRIDER. That is correct, sir. I have information on who selected each site.

Senator BOGGS. You have that information?

Colonel STRIDER. Yes, sir.

Senator BOGGS. Who made the final determination on the site under discussion today—the one 12 miles offshore?

Colonel STRIDER. I think that is what Mr. Sam Baxter just mentioned: that he was the one who selected that site—the city of Philadelphia.

Senator BOGGS. The corps doesn't have to approve the site?

Colonel STRIDER. No, sir; we have no authority outside the 3-mile limit.

Senator BOGGS. There is no authority in anybody's hands?

Colonel STRIDER. That is the way I understand it; yes, sir. Past the 3-mile limit anyone can dump anything, anywhere, under present law.

Senator BOGGS. Offhand, how far off Rehoboth Beach does the Continental Shelf run?

Mr. CABLE. It is over 100 miles, sir.

Senator BOGGS. Over 100 miles. What are the depths out to the edge of the Continental Shelf?

Mr. CABLE. It goes to about 100 feet; then it drops sharply to almost a mile, 6,000 feet, once you get beyond the Continental Shelf.

Senator BOGGS. Have you reached any conclusion in your own mind, or has the corps made any studies on the effects of ocean dumping beyond the Continental Shelf?

Colonel STRIDER. No, sir; we have not.

Senator BOGGS. Does the corps conduct spot checks to insure that the material is placed at the specified areas?

Colonel STRIDER. Yes, sir; we have on several occasions, both by sea and by air. We have made spot checks to see that they were dumping in the designated locations.

Senator BOGGS. Have you found any evidence of short dumpings?

Colonel STRIDER. On one occasion; yes, sir.

Senator BOGGS. I don't think that I have any further questions. I want to thank you, Colonel. The subcommittee may, as it continues its investigation, want to ask you to come back again.

Colonel STRIDER. We would certainly be delighted.

Senator BOGGS. Thank you both very much for coming.

Colonel STRIDER. Thank you for having us, sir.

(Colonel Strider's prepared statement follows:)

PREPARED STATEMENT OF COL. CARROLL D. STRIDER

I am Colonel Carroll D. Strider, District Engineer of the Philadelphia District United States Army Corps of Engineers. The Philadelphia Engineer District encompasses Delaware River Basin and Delaware Bay within its boundaries. We, in the Philadelphia District, and with the cooperation of ocean dumpers, have taken it upon ourselves to maintain an inventory of the material which leaves the Delaware Bay for ocean dumping. My appearance before this Committee is to provide information from our records of ocean dumping of waste materials.

The Corps of Engineers has regulatory authority to control dumping of all refuse into the "territorial waters" of the United States. Such authority comes from Section 4 of the River and Harbor Act of 1905 (33 U.S.C. 419) and Section 13 of the River and Harbor Act of 1899 (33 U.S.C. 407). On the other hand we have no general power to regulate dumping of anything beyond the "territorial waters" of the United States.

All of the waste material which is carried out through the Delaware River is disposed of beyond these "territorial waters". At least we have no knowledge to the contrary. (Territorial waters are customarily defined as the three-mile limit). In fact, most of the dumping is taking place on the high seas, beyond even the contiguous zone which is generally identified as the 12-mile limit. Nevertheless, we in the Philadelphia District have solicited cooperation from ocean dumpers in order to:

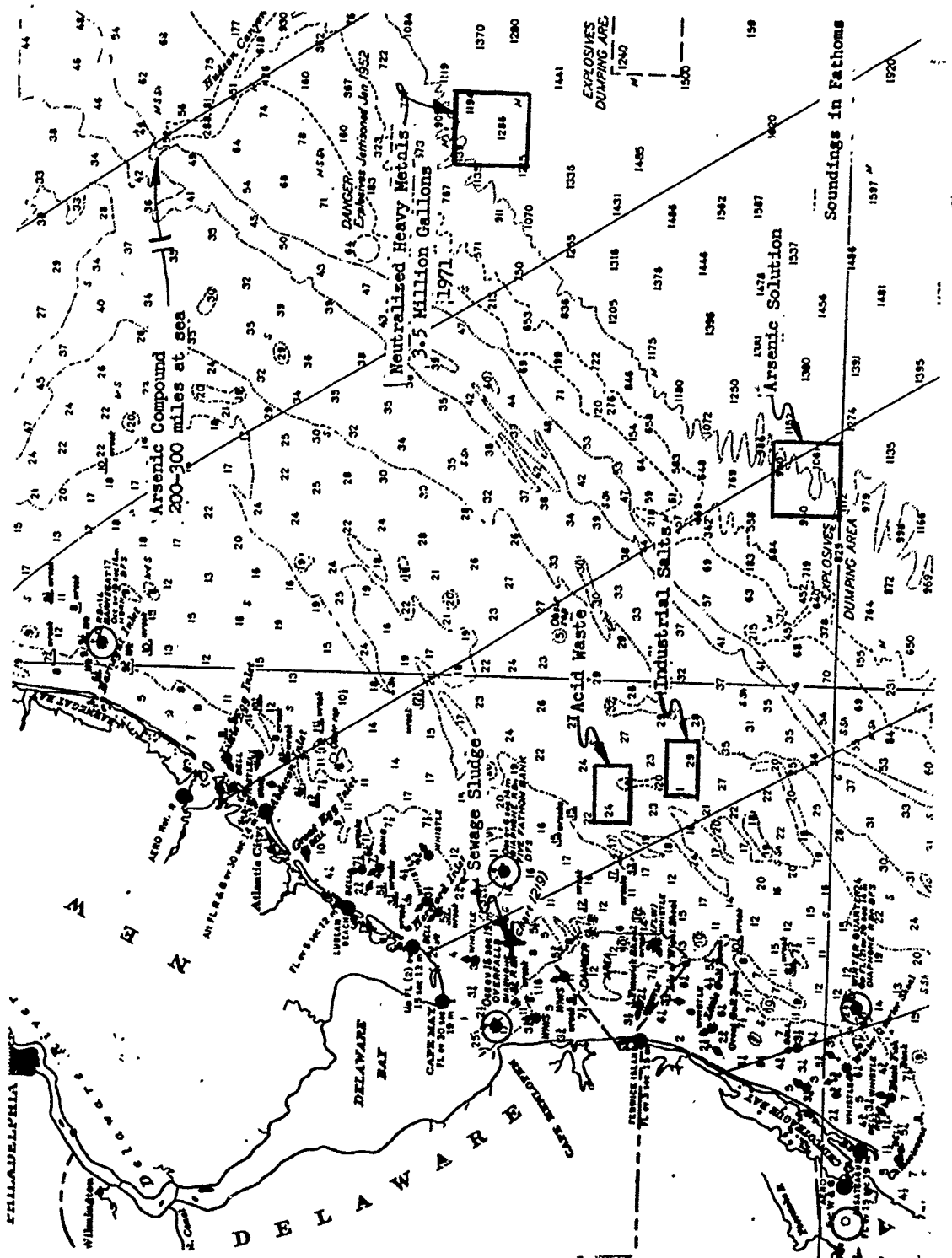
- (1) Maintain an inventory of what is dumped.
- (2) Confine dumping in specific areas only.

The purpose of this has been two-fold. First it appeared to be worthwhile knowledge to have a record of what was being placed in the ocean, and secondly it seemed advantageous to confine dumping to specific areas so that deleterious effect, if any, would be limited. I have attached to my statement a copy of a map showing the location of the various dumping areas being used. Each firm engaging in towing or shipping of wastes for ocean dumping is requested to provide my office with a copy of their barge loading chart and their tub log. We have made some spot checks to assure that material is being placed in specified areas. We believe that our efforts in inventorying and confining have been successful and can provide some basis for evaluating the impact of the dumps on the oceans environment. At present, material which is being dumped is divided into one of the five following categories; sewage sludge, acid wastes, arsenic solutions, arsenic compounds, and industrial sites. I'll expand on each of these categories to indicate volume and trends. First, the sewage sludge area is located approximately 11 miles out in the Atlantic Ocean. Sewage sludge has been dumped at this location for 10 years as the first recorded dumping took place in 1961.

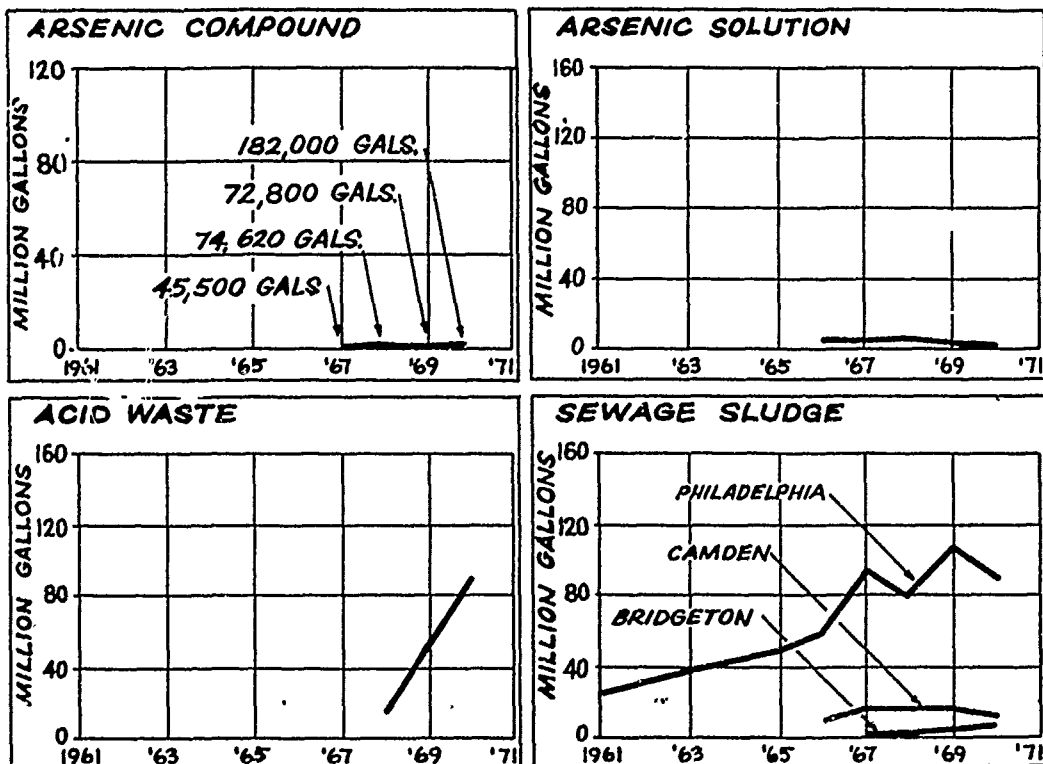
During this past year the cities of Philadelphia, Camden and Bridgeton contracted for the hauling and dumping of 106 million gallons of sewage sludge into this area. This is about 15% less than was dumped here during the prior year. In total, about 730 million gallons have been deposited in this area since it was first used in 1961. The next category of material is acid wastes. 90 million gallons were deposited in 1970; 37 miles from the mouth of Delaware Bay. This was up from 1969, when 60 million gallons were placed in this area. The arsenic solutions have been delivered 97 miles out in the ocean. Volume here has decreased from 4.25 million gallons in 1969 to 2.9 million gallons in 1970. The arsenic compounds have been loaded aboard ocean vessels, in sealed drums, and taken at least 200 miles out in the ocean. Volume in 1969 was 70,000 gallons; increasing to 175,000 gallons in 1970. The industrial salt dump, first used this past year, is located 47 miles out and the volume was 5 million gallons.

A new dump approximately 130 miles from Cape May was utilized during the past several months for dumping of 3,500,000 gallons of neutralized heavy metal wastes. It should be noted that the products which have indications of being the most harmful are deposited where the ocean is a mile or more in depth.

In conclusion, we in the Corps of Engineers feel that our efforts have resulted in a reliable inventory of materials and have confined materials to specific locations. That this much has been achieved is a manifestation that industry and municipalities, who are beset with problems of waste disposal, have cooperated and have not conducted their disposal operations surreptitiously. Thank you for this opportunity to present this information to your Committee.



BEST COPY AVAILABLE



Mr. CABLE. Thank you, sir.

Senator Boggs. Our next witness will be Dr. William Gaither, College of Marine Studies, University of Delaware.

Dr. Gaither, we are very honored to have you here. We will file your statement as if it were read completely and you may summarize it, if you wish. Please proceed.

STATEMENT OF DR. WILLIAM S. GAITHER, DEAN, COLLEGE OF MARINE STUDIES, UNIVERSITY OF DELAWARE, NEWARK, DEL.

Dr. GAITHER. Thank you very much.

Mr. Chairman, members of the committee, ladies and gentlemen, my name is William S. Gaither. I am a civil engineer, dean, and professor of the College of Marine Studies of the University of Delaware. Within the university I am also director of the Delaware Sea Grant program of the National Oceanic and Atmospheric Administration. Within the State I am a member of the Governor's Task Force of Marine and Coastal Affairs as well as a member of his council on science and technology.

With me is Dr. Thomas Myers, assistant professor of marine biology in the College of Marine Studies. Dr. Myers has for some time been actively engaged in studies which relate specifically to ocean dumping.

We of the College of Marine Studies wish to thank Senator Muskie and Senator Boggs for inviting us to present our views on ocean dumping at this hearing.

Specifically, we were asked to discuss the scientific analyses undertaken by the college on material dumped into the ocean with emphasis on what criteria the Federal Government might use in selecting future ocean dumping sites.

PHILOSOPHY

Our view on ocean dumping is simply this: We believe that enough is now known about the effects of waste disposal in the oceans to justify significant curtailment of the practice. To us it seems apparent that uncontrolled dumping will eventually lead the oceans to a fate similar to that which has befallen Lake Erie.

On the other hand, as a practical matter, it is not possible to immediately discontinue the disposal of all pollutants into the ocean.

Much of what has been written concerning the effects of ocean dumping is ably summarized by the report to the President prepared by the Council on Environmental Quality entitled, "Ocean Dumping, A National Policy."¹ (See appendix.)

Rather than belabor this committee with details, my personal recommendation is that the policy and regulatory recommendations made by the Council on Environmental Quality be enacted into legislation promptly.

ANALYSES BY THE COLLEGE OF MARINE STUDIES

Surveys and studies conducted by the College of Marine Studies, or other, which bear on dumping in the Delaware Bay or on the adjacent Continental Shelf are summarized in the following sections:

(A) *The Philadelphia sewage sludge dump.* The University of Delaware has done no systematic work on this dump site, nor, to the best of my knowledge, have we been approached to consider such work. We have, however, furnished equipment and vessels to support studies by the public health service laboratory for water quality at Narragansett, R.I.² Dr. Myers has done hydrographic sections and plankton surveys across the general area for three summers, 1968 through 1970, in a section from Breakwater Harbor to Five Fathom Bank lightvessel. He has done no benthic work at that site.

(B) *The Du Pont iron-acid waste disposal site.* Dr. Myers holds a 2-year contract from the Du Pont Co. to evaluate the biological effects of their iron-acid waste disposal operation off the Delaware coast. The physical-chemical parameters are evaluated by Hydroscience, Inc., under contract to Du Pont. These monitoring operations are funded in large part by the Environmental Protection Agency's Water Quality Office under a demonstration grant to Du Pont.

The waste consists largely of iron sulfate and sulfuric acid, which comes from the production of titanium dioxide pigment at the Edgemoor, Del., plant. The waste is moved to sea in a specially designed 5,000-ton barge two or three times each week. The designated disposal area enclosed a rectangle 5 by 8 miles centered approximately 38 nautical miles southeast of Cape Henlopen, Del. Water depths are 40 to 45 meters in most of the area. The University of Delaware and Hydroscience made on survey, May through June 1969, in the area before disposal began. Disposal started in July 1969. We have continued a monitoring program at about 2-month intervals, since disposal began

¹ Train, R. E., R. Cahn, and G. J. MacDonald, 1970. Ocean Dumping—A National Policy. A report to the President prepared by the Council on Environmental Quality. 45 p.

² Buelow, R. W. 1968. Ocean Disposal of Waste Material. Contribution No. 28 from Northeast Marine Health Sciences laboratory, National Center for Urban and Industrial Health, Bureau of Disease Prevention and Environmental Control, Public Health Service, Department of Health, Education, and Welfare, Narragansett, R.I., 02882.

in that site. Results of field studies show no significant changes in species diversity of macrobenthic organisms in the disposal area although certain species, such as the sand dollar, have shown some reduction in numbers.

It should be noted that prior to July 1969, this material was dumped at a site further out to sea. We do not have any particulars but understand that it was continued for 6 to 8 months. This operation was not monitored, insofar as we know. Du Pont used this alternate site until the primary site could be studied with at least one "before" survey. We, of course, realize the limitation of having only one predisposal survey.³

(C) *Sedimentary and Physical Studies*. Next, there are several sedimentary and physical studies which should be described. Studies on the transport of sediments in the Delaware Bay region by university geologists have shown that "the lower bay is filling with coarse materials probably derived from the Continental Shelf and the ocean shores."⁴ This observation by Dr. Jordan is in agreement with studies by Bumpus who demonstrated "a definite residual drift toward the mouths of estuaries" in bottom waters on the Continental Shelf in the middle Atlantic Bight area.⁵ Further, Bumpus states that, "offshore of a line, drawn about one-half to three-quarters of the distance between the shore and the 50-fathom contour, at ~~depths of~~ 30 to 35 fathoms, the tendency is toward an offshore drift. Inside of this line, the tendency is for the flow to be westerly or southerly with a component toward the coast."

Now, this is important: based on the above considerations, it would appear that bottom current transported pollutants dumped inshore of the 180-foot contour line of the Continental Shelf have a high probability of being partially returned to our mid-Atlantic bays and coasts. Although the implication is clear, more geological and hydrographic research should be conducted to confirm these observations.

Other relevant surveys and studies done on the Delaware shelf, by Dr. Kraft and others of the college of marine studies, include past seismic and bottom sampling programs by the department of geology which were aimed at determining the nature of the bottom sediments and their thickness in the near-shore marine area. An extensive program of work on the Delaware Bay area and near-shore marine area is planned based on funds provided to the University of Delaware NOAA-sea-grant program. Initial sampling and seismic work on this program will begin in the summer of 1971 and be continued with an increased intensity in 1971-72. We may, however, have a problem in directly relating our work to the ocean dumping problem should University of Delaware funds requested from sea grant be cut for the 1971-72 year.

Dr. Swain attempted to do a one-sample analysis of a dumping area about a year ago. However, he was not properly funded and accordingly not able to really get into the problem. In our opinion, the only possible way to evaluate dumping and its effect on the Continental Shelf in the Delaware and adjacent water area is to properly map the

³ Myers, T. D. 1971. Personal Communication.

⁴ Jordan, R. R. 1968. Suspended and bottom sediments in the Delaware estuary. Abstract, Geol. Soc. of Amer., Northeastern Sec. 3d Ann. Meeting, p. 37-38.

⁵ Bumpus, D. F. 1965. Residual drift along the bottom on the Continental Shelf in the middle Atlantic Bight area. Limnol. and Ocean. 10 supplement: R50-R-53.

areal distribution of the bottom sediments and evaluate them in terms of their organic and inorganic geochemistry. We have proposed a program to do this on a reconnaissance basis in Delaware Bay. However, there is question about sea-grant funding being available for this purpose. Planned broad coverage map studies and evaluation of the equality of the sediment could be directly compared with the nature of the sediment and its alteration in the dumping areas (Kraft, 1971).

We have not for this hearing addressed the matter of fisheries or pollution monitoring in Delaware waters since these matters will be covered by other groups.

(D) *Criteria for Ocean Dumping Site Selection.*—The question of establishing criteria for ocean dumping site selection is extremely complex. First, the oceans and estuaries are all part of a dynamic system and as a result the waters are always in motion. Some parts move rapidly while others move with imperceptible slowness. At the present time we know the bottom topography of oceans and bays with generally accepted accuracy to draw gross conclusions. But, we understand the nature of the major ocean currents and the action of tides in estuaries with much less accuracy.

Second, our knowledge of the short- and long-term behavior of material dumped into the ocean is meager indeed. Once dumped into the sea, some material will float to the surface, some material will sink to the bottom, and some material will go into solution. Each component will move to new locations as a result of currents and bottom configuration. Chemical reactions may continue for long periods.

Finally, and to us most important, the effects of dumped material on marine life and man are virtually unknown except in cases of gross and toxic pollution.

These obvious problems point to the need for baseline knowledge of any site proposed for ocean dumping. In addition, a potential site cannot be regarded as an isolated static location but must be understood as part of the larger oceanic circulation system.

The solution then requires a threefold approach:

First, the United States must undertake baseline surveys of its estuaries and coastal waters to understand the total physical, geological, chemical, and biological systems. It must also exercise leadership in multinational programs to undertake baseline surveys of the world's oceans.

Second, pilot studies must be conducted prior to the start of ocean dumping to determine both the short- and long-term effects of specific dumped material; and,

Third, a synoptic monitoring system must be installed to give early warning of unexpected effects.

(E) *Future Programs of the College of Marine Studies.* The College of Marine Studies is well qualified to expedite the recommendations made on ocean dumping by the Council on Environmental Quality. In particular, it is actively planning a baseline survey of Delaware Bay for the Governor's Task Force on Marine and Coastal Affairs. This survey should be extended in scope to include the waters of the Continental Shelf and slope.

The college is centrally situated with laboratories on the Newark campus and a field station at Lewes, Del., to conduct both field and laboratory research. We believe that although the gross effects of ocean dumping are reasonably well documented, additional information is needed on such matters as:

1. The sublethal effects of ocean pollutants on marine life in general;
2. Bioaccumulation of toxic materials in food chains;
3. The effects of ocean discharges on biotic community structure and species diversity;
4. Transport of pollutants by currents and other forms of dispersion; and
5. Potential direct and indirect effects on man.

In summary, I stand behind the recommendation of the President's Council on Environmental Quality to "ban unregulated ocean dumping of all materials and strictly limit ocean disposal of any materials harmful to the marine environment."

In addition, the faculty and facilities of the College of Marine Studies stand ready to aid the State, the region, and the Nation in gaining a more complete understanding of its marine resources and environment.

Thank you, sir.

Senator Boggs. Thank you, Doctor, for your very fine and helpful statement. We value the work that you and the University of Delaware are doing.

You heard the statement given by Doctor Erb of the Franklin Institute?

Dr. GAITHER. Yes, sir.

Senator Boggs. I understand that the University of Delaware may participate with the Franklin Institute in their research. Is that contemplated?

Dr. GAITHER. No; they have not approached us about any cooperative efforts. I did note that we had furnished vessels for the use of the Narragansett Marine Laboratories but there have been no overtures for cooperation to the best of my knowledge.

Senator Boggs. Have you reached any conclusion in your studies—and you certainly are fair to indicate that there is need for much more research—that ocean dumping should be limited to areas beyond the Continental Shelf?

Dr. GAITHER. I think we have a separate problem there and that if we regard the long-term well-being of the oceans as important, that to arbitrarily begin dumping beyond the Continental Shelf at this time might well be more of a long-term detrimental situation than if we were to dump on the shelf.

Doctor Myers, would you like to add anything to that?

Dr. MYERS. Yes. Mr. Chairman, I have been somewhat concerned about the proposition advanced this morning and the number of pieces of legislation proposed about extending all dumping to at least a hundred miles out, or at any rate, beyond the Continental Shelf. Essentially what we are doing in this proposal is the same thing that we did 5 or 10 years ago inland; we don't want to see the material deposited in our fresh water streams so we dump it in the ocean; and now those of us who are along the coastal areas don't want to see it there so we advocate taking it further out.

There is an additional problem and that is if these materials are dumped in deep water some kinds of it, by no means all, but some kinds of it are subject to biotic degradation. If we dump it into deep water, very deep water, there is the possibility that degradation will be extremely slow, much slower than it would be up on the shallower

waters of the Continental Shelf. To give an example, we might take the thing which was featured in the news media a few weeks ago on the famous sandwiches which were recovered from the research submersible Alvin of Woods Hole Oceanographic Institution which had been submerged in deep water for many months and were retrieved virtually intact with no biological degradation, quite soggy, to be assured.

Senator Boggs. Thank you for those comments.

Doctor Gaither, it seems that you and Doctor Myers are saying that because of lack of baseline knowledge you are not surprised by the apparent conflicting testimony between the FDA and the Franklin Institute?

Dr. GAITHER. I think this is true, and I think this point relates particularly to the question of dumping beyond the shelf because once we dump there the problems that Dr. Myers cited are very important. The second problem is that we now would be depositing directly in the Gulf Stream, so we could degrade the quality of the entire Gulf Stream circulation system with no measurable or apparent effects at the particular dump site simply because the dumped material would have been carried away, possibly to be degraded farther on.

Senator Boggs. We thank you both for your contribution. We appreciate your presence here today.

Dr. GAITHER. Thank you.

Senator Boggs. I would like at this time to enter into the record the statement of William A. Hasfurther, who is the chief of the Division of Waste Water of Baltimore City.

(Statement follows:)

STATEMENT OF WILLIAM A. HASFURTHER, CHIEF, DIVISION OF WASTE WATER,
CITY OF BALTIMORE, MD.

My name is Wm. A. Hasfurther and I am chief of the Div. of Waste Water, Baltimore City. I spent over 20 yrs. with the Illinois Sanitary Water Board the pollution control regulatory agency in Illinois and 14 years with the Anne Arundel Co. Sanitary Commission and Baltimore City, planning, building and operating sanitary facilities.

The City of Baltimore had a study made by Whitman Requardt and Assoc. in 1965 covering sludge disposal and accepted the recommendation to barge digested sludge to the Atlantic Ocean. This program was chosen because the report and other studies showed a great dollar saving in barging over other methods. None of the other methods studied entirely eliminated sludge residue and the cost of disposing of these was not included.

In 1967 Baltimore applied by letter for a Federal construction grant to aid in the barging program and approval by letter was obtained from the WPCA providing we agreed to certain conditions regarding monitoring and selection of a disposal site. These were agreed to. No formal application was made since the dollar cost of the project was uncertain—it could vary by what was then estimated at several million dollars, depending upon the choice of a transfer point. That is land to barge.

In 1968 consultants were retained to provide a report and data that could be used as a basis for final design at the facilities. The problem of selecting a transfer point delayed this work and the report was not completed until Oct. 1970. It was submitted to the E.P.A. and in Jan. 1971 we were informed that because of recommendations made by the Counsel on Environmental Quality to the President that office could no longer recommend a Federal construction grant. Note that we were not told that we could not barge to the sea if we were willing to pay the full cost of the program.

Baltimore because it could not support the full cost of the program and because we do not choose to go against the will of the people along the coast until some action is taken to dispel their fears set aside its barging program and is en-

deavoring to find another solution for the disposal of over 60 dry weight tons of solids per day.

This decision not to barge is not founded on any proof that disposal of sludge at sea would be harmful to the environment. While I respect the fears of the people along the coast, I prefer that regulatory agencies base their decisions on studies and facts. In all my years with such an agency I never urged action unless I had data to support my recommendations. On the other hand in 1962 following my recommendations the Anne Arundel Co. Sanitary Comm. approved that all plants, built in the Co., including those discharging to the Bay, provide secondary treatment. This despite the fact that we could not get the State to provide as with a letter saying that secondary treatment was desired.

I have never seen any data that would show that disposal of sludge in controlled quantities in defined areas of the ocean would be detrimental. The data on the New York harbor area does show bad conditions, but here we have no control in an area too close to shore and much more than sludge is being dumped.

I do not favor changing the policy of controlled dumping until a complete study can be made by competent and objective persons. In 1968 we appeared before the Md. Board of Natural Resources to request their approval of Ocean Dumping and a suggestion was made by one of their members that an ocean study be made from Maine to Norfolk, Va. I understand that this has been started in a limited way—but unless a complete study can be made neither those in favor of dumping nor those opposed will ever be satisfied. Many, especially those opposed will never be satisfied unless their desire is approved and this committee must carefully weigh the pressures placed upon it to determine if they are based on fact or on hysteria.

Senator Boggs. Mr. Elliott Clemence, Interstate Oil Transport Co.

STATEMENT OF INTERSTATE OIL TRANSPORT CO., PHILADELPHIA, PA., REPRESENTED BY MR. HALDERMAN

Mr. HALDERMAN. Senator, my name is Halderman. Mr. Buchanan was supposed to be here but sometime last night he was involved in an automobile accident.

Senator Boggs. I am sorry to hear that. Are you representing Elliott Clemence?

Mr. HALDERMAN. Yes, sir.

Senator Boggs. He is not going to be here. Are you with Interstate Oil?

Mr. HALDERMAN. I am with the Interstate Oil Transport Co. from Philadelphia.

Senator Boggs. I am sorry about the accident, but we are glad to have you. You can go ahead and make your statement.

Mr. HALDERMAN. I have no prepared statement, Senator.

This business of dumping at sea is less than 1 percent of our business and we do haul for three different companies, Gulf, DuPont, and Rohm & Haas, and they are roughly in the area of 50 miles at sea and 100 miles at sea. So any information that my company can give to the committee, we will be more than glad to furnish any information at all.

Senator Boggs. Your company is a hauler?

Mr. HALDERMAN. We are a hauling and barging concern; yes.

Senator Boggs. Can you describe for us what you do when you reach the dumping site; how is the job done?

Mr. HALDERMAN. Our barges are all equipped with self-contained pumping units and at the loading installations it is loaded with pipelines into our barge area. In turn we tow these barges to sea, our bearings are fixed by loran navigational aids and when we reach these designated areas these barges are discharged.

Senator Boggs. Is the barge moving while you are dumping?

Mr. HALDERMAN. It is a continuous operation. With the Du Pont barge it takes about an hour and a half; with our conventional pump barges it might take 6 to 8 hours.

Senator BOGGS. And you go out 40 to 50 miles?

Mr. HALDERMAN. Our nearest dumping area is the Du Pont area which is, I think one gentleman says, roughly 37 nautical miles, something like that.

Senator BOGGS. Do you have any estimate of the volume of wastes you dump each month?

Mr. HALDERMAN. No, sir; I do not, not at this time. I came very ill-prepared for this.

Senator BOGGS. Could you give us the name of the materials that you dump for each of these three companies?

Mr. HALDERMAN. No, sir.

Senator BOGGS. Would you furnish that for the record, please?

Mr. HALDERMAN. Yes, sir.

Senator BOGGS. And can you furnish us with information on the volume that you dump each month?

Mr. HALDERMAN. Yes, sir.

(Mr. Halderman subsequently supplied the following:)

INTERSTATE OIL TRANSPORT CO.,
Philadelphia, Pa., April 1, 1971.

HON. EDMUND MUSKIE,
Subcommittee on Air and Water Pollution,
U.S. Senate, Washington, D.C.

MY DEAR SENATOR: As you requested at your hearing in Rehoboth Beach, Delaware on March 26, 1971, we are submitting information regarding the dumping of liquid waste at sea. The following represents the past 25 months activities:

For Gulf Oil Corp. we transport Spent Caustic Soda:

Chemical Name: Used Sodium Hydroxide (6% to 8% caustic solution) NaOH.

Common Name: White Caustic Soda—used to scrub contaminants from various refinery streams. The normal state is liquid, color is amber and odor is sour. Sp gr. @ 60°F is 1.115.

Boiling Point: 215°F.

Freezing Point: 18°F.

Vapor Pressure: at 70°F is 0.002 psia, at 100°F is 0.06 psia, at 115°F is 0.10 psia, at 130°F is 0.14 psia.

Specific Viscosity at 60°F is 2.0.

Solubility in water at 100°F is completely soluble.

Impurities: 1. Sodium Sulfide Na₂S approx. 0.6%, 2. Sodium Phenate C₆H₅Oa approx. 0.6%, 3. Sodium Butyl C₄H₉SNa approx. 0.9% Mercaptide.

Quantities Carried: 1-1-69 to 6-30-69, 118,050 barrels; 7-1-69 to 6-30-69, 230,293 barrels; 7-1-70 to 1-31-71, 92,754 barrels.

This material has been carried a minimum of fifty nautical miles off-shore.

For Whitmoyer Laboratories of Myerstown, Pennsylvania, a subsidiary of Rohm and Haas, we transport waste arsenic solution from Paulsboro, New Jersey to a distance of at least 100 nautical miles at sea.

Quantities carried: 1-1-69 to 6-30-69, 48,591 barrels; 7-1-69 to 6-30-70, 94,178 barrels; 7-1-70 to 1-31-71, 42,584 barrels.

For E. I. duPont deNemours we transport Aqueous Waste Solution (approximately 2% dissolved organic materials, less than 0.1% settable solids) from Seaford, Delaware to approximately 50 nautical miles east of Cape Henry, Virginia.

Quantities carried: 1-1-69 to 6-30-69, 51,241 barrels; 7-1-69 to 6-30-70, 289,395 barrels; 7-1-70 to 1-31-71, 26,795 barrels.

In addition to the wastes carried above, we have a towing contract with E. I. duPont deNemours to tow the barge EDMOOR I from Edgemoor, Delaware to the disposal areas designated by duPont in the Atlantic Ocean.

Very truly yours,

DAVID C. BUCHANAN,
Manager of Operations.

Senator BOGGS. Do you have to take any particular precautions to make certain that you are in the dumping area, and that you don't dump short?

Mr. HALDERMAN. Well, we are dependent upon our capable captains by taking these various loran bearings. We have had people going along at different times to make sure that we do dump in the pre-designated area. I don't believe we have ever had any complaints about dumping short.

Senator BOGGS. Your captains keep logs on all that?

Mr. HALDERMAN. Yes, sir.

Senator BOGGS. Thank you very much for being here. We want to get the whole picture.

Mr. HALDERMAN. I am sorry I came so ill-prepared but at 4 o'clock in the morning I didn't have much choice.

Senator BOGGS. I am very sorry to hear about the accident. Please give our regrets to Mr. Buchanan. If you would furnish the information to us, it would be helpful.

Mr. HALDERMAN. We certainly will. Thank you.

Senator BOGGS. Now, we have a panel of fishermen and clammers: Capt. Joseph H. Niblett of the Indian River Inlet Captains' Association; Capt. Otto Stocker of New Jersey; Mac Simpson, president of the Ocean City Marlin Club; and Mr. Jerry Defoe of the Delaware Underwater Swim Club.

PANEL: CAPT. JERRY DEFOE, DELAWARE UNDERWATER SWIM CLUB; CAPT. JOSEPH H. NIBLETT, INDIAN RIVER INLET CAPTAINS' ASSOCIATION; CAPT. OTTO STOCKER, NEW JERSEY; CAPT. MAC SIMPSON, PRESIDENT, OCEAN CITY MARLIN CLUB; CAPT. CLARENCE SHOFFLER, CAPE MAY-WILDWOOD, N.J.

Captain DEFOE. Thank you. Before I start I ought to mention I thought everybody had 10 minutes, so I put mine on tape. With your permission we can lower the lights and get mine over with quickly. And may I submit for the record, the endorsements I have received for my appearance here?

Senator BOGGS. You may, Captain. They will be included in the record at this point.

AMERICAN LITTORAL SOCIETY,
Highlands, N.J., March 16, 1971.

Mr. GERALD A. DEFOE,
Delaware Underwater Swim Club,
Wilmington, Del.

DEAR MR. DEFOE: To confirm our recent telephone conversations, we would like you to represent the American Littoral Society at the Committee hearings in Delaware on Friday, March 26, in the event that I will not be able to attend in person. The following statement sums up our position:

The American Littoral Society commends the concern of Congress over the well-being of the marine environment of Delaware Bay and the waters of the Atlantic coastal shelf. As knowledge of coastal zone productivity accumulates it becomes apparent that man can no longer consider coastal waters a legitimate dumping ground.

The argument that we cannot afford other dumping sites is unsound. To the contrary, we cannot afford to destroy valuable land and water at the edge of the sea.

The fact that both New Jersey and Delaware have formed commissions to help plan for the future of Delaware Bay indicates the concern of these states for sound management of a valuable natural resource. To the extent that the federal government can assist in this goal, its interest is most welcome.

Please be sure that the above statement is made part of the record of the hearing. It represents the position of the 3000-member American Littoral Society.

Sincerely,

D. W. BENNETT,
Conservation Director.

MIDDLE ATLANTIC UNDERWATER COUNCIL,
Philadelphia, Pa.

TO WHOM IT MAY CONCERN: This is to advise that the Middle Atlantic Underwater Council would like to have a representative present at the Senate Hearings on March 26, 1971. We understand that the topic of these hearings is "Ocean Dumping".

The Middle Atlantic Underwater Council is the parent organization for most of the diving clubs in Pennsylvania, New Jersey, Maryland and Delaware. It has in its organization approximately 500 members. As divers we spend much of our spare time under the water, and it is our deep concern to have the ocean dumping stopped. It not only is detrimental to us as divers, but also to our entire underwater habitat.

We would like to have Mr. Gerald DeFoe represent the Middle Atlantic Underwater Council at these hearings. We feel that Mr. DeFoe has our deep concern at heart and will add another dimension to these hearings.

Very truly yours,

LES ECKSTEIN, *President.*

Senator Boggs. This is a very interesting panel. Mr. Jerry Defoe from Wilmington has some taped comments together with some slides. We will turn down the lights; please proceed with your testimony.

Captain DEFOE. My name is Jerry Defoe from Wilmington, Del. I am a member of the Delaware Underwater Swim Club, Inc., and the Diamond State Skindivers. Today I am also representing 500 members of the Middle Atlantic Underwater Council and the 3,000 members of the American Littoral Society of Sandy Hook, N.J.

I started diving in 1952 and have been diving off Delaware since 1959. In the beginning years, through the early sixties, our inlets, jetties and offshore wrecks abounded with marine life and visibility underwater was measured in feet. Today, we generally measure it in inches.

Let's take a look at our water visibility from the fish's point of view.

Divers, they say, are an odd lot, some of them will go to any lengths to go diving, even to going in minus a leg. We go out to our breakwater full of hopes and vigor, getting our final instructions from the dive-master, hoping the water visibility will be like Florida's.

Of course, we realize that it can't be that clean because of the geological rock structure, and we know we can't get the pretty pictures like they do in the Bahamas. We also realize we can't have the visibility as they do, and we are not going to see the fish as pretty and as plainly as these.

But, gentlemen, here is a picture from Maine. Notice how the lobster and the fish seem to be criticizing man for throwing a beer can overboard. Also, notice in Maine how clear the water is.

Also consider the size of this lobster and these fish from Chincoteague, Virginia. They also live in clean water.

Well, let's look at the Delaware breakwater on a typical day. Can you see the fish? How about now? How about now? Oops, that was my buddy and he is only 3 feet away.

Let's try the south jetty at Barnegat, N.J. on a day that underwater visibility was considered to be excellent. Looking into the rocks at 25 feet using flash doesn't look very promising, even from the surface things aren't too bright, but we did see a school of bait fish on the ebb tide at 15 feet, and a blowfish at 25 feet. We even saw a crab hiding under a rock while the fish on the left tried to get away. On the same day we even saw a bashful horseshoe crab at 30 feet. We had to use flash in all these, of course.

Later that week we decided to use some tanks and try the offshore wrecks. That day was September 14, 1968; we were diving on the Pig Iron wreck laying in 60 feet of water, 5 miles off Seaside Park, N.J., and this is what we found—a starfish eating an ocean pout. That is impossible, you say, for a starfish to catch an ocean pout—not if the ocean pout is dead.

That blue thing at the top is a dead crab covered by fungus. Almost everything on that wreck was dead.

We went home and waited until September 29, 1968, and decided to try the Mohawk; she lays in 85 feet of water, 8 miles off Montoloking, N.J.—one of our favorite wrecks for lobster. They didn't look very healthy that day and our marine biologists say they died from lack of oxygen. Isn't that a pity? We think someone, somewhere put something in the water to cause this.

Gentlemen, we are demanding that you stop them now, whoever they are. Please don't let them destroy our beautiful ocean.

It is not too late yet. As you can see from these pictures taken from the Washingtonian, laying in 75 feet of water, 6 miles off Indian River Inlet in Delaware in 1970, we still have some fish and some beauty.

But look at this shark. Let's clean up our water so if we see him again we won't have to look through the silt and sediment to see him plainly.

Senator Boggs. Thank you, very much, Mr. Defoe. Those were very interesting pictures.

Now, Captain Niblett. Will you introduce your colleagues?

Captain NIBLETT. Right here on my right, Clarence Shoffler, of the Cape May-Wildwood area; Capt. Otto Stocker, of the same area; and this is Captain Simpson, from Ocean City, Md.

Senator Boggs. Will you proceed, Captain. Any written statements you have will be made a part of the record.

Captain NIBLETT. I think the first thing we will show you, Senator Boggs, would be a map that we have over here so you will know exactly what we are speaking of. You see, the circle is the contaminated area and right in the middle of the square spot, that is the dumping spot.

Senator Boggs. This is the Delaware coast and this is New Jersey.

Captain NIBLETT. That is right, and that square spot in the middle is supposed to be the center of the dumping area and the round circle is the area that is contaminated at the present time.

Our first speaker will be Capt. Otto Stocker.

Captain STOCKER. I am Captain Stocker of Wildwood, N.J. I consider that I was personally responsible for alerting the State, county, and municipal officials as to the seriousness of conditions in our area. At my own expense, with the cost running into hundreds of dollars, I advertised the problems with open letters to the public, alerting them and calling attention to the negligence of public officials who were doing nothing to halt the contamination of our area.

We feel that our scheduling at this hearing is practically an insult. We have been made to wait until 4:10 p.m. before being allowed to testify about the situation concerning the effects of the contaminated area.

Mr. Shoffler and myself went to great expense—it costs us quite a few thousand dollars—to bring this whole group together in Delaware. Now we are compelled to hurry our presentation and the Senators that were here have left and many of the people have left. I am very grateful that we still have people left who are still interested. Our time is limited and I have got to leave here at quarter after and I am going to leave this organization, period, but I am not going to be finished with this subject even though I am disappointed at today's proceeding.

Having spent 43 years of my life in the area in all phases of fishing and general business, and with those involved with same activities, I am known to and know families that have spent from 25 to 60 years in all types of fishing in the area which is now contaminated.

I am quite sure their present experiences of trying to make a living in these contaminated areas would be interesting listening, also. These are vital problems to all of us since they affect our personal livelihood.

The gentleman from the Franklin Institute claim there is no dead sea as the maps indicated.

This area was condemned by the Federal Government as contaminated—an area 12 miles in diameter, $5\frac{3}{4}$ miles from Cape May Harbor Inlet and 7 miles from Delaware.

Gentlemen, there is no way to really tell how far this is spreading.

Local fishermen will testify they have seen the barges dump long before they get to the designated area. The barges have no one on these trips who is a responsible authority who will see that they do not dump outside the authorized area.

By comparison 15 to 20 years ago party and pleasure boats had no trouble getting potato sacks full of croakers, sea bass, and so forth. Nowadays, sea bass pot fishermen use 1,700 pots to get fewer fish than they did when they only used 70 to 100 pots. There are now only three pot fishermen left in the area. The draggers do not need the fancy electronic equipment they use today, costing in the tens of thousands of dollars. These particular draggers find when their gear comes up it is covered with a thick, oily slime. This is on the edge of the contaminated area and it seems almost impossible to remove it from the gear. And the warning that you can't ignore is that it is spreading to a larger area. And it is spreading shoreward. All of the partyboats, pleasure boats, and draggers have tried the area time and again, to no avail.

I have taken divers down and been down myself in years gone by, and we have found changes in fish life and bottom growth. Most of it is dwarfed and undersized and sick.

In the summer of 1970, some of the partyboat captains told me that while cleaning fluke they had caught, the backs literally fell off—these were caught on the outside edge around Mecray Shoal Light. There are fish within that contaminated area plenty full of rot, but I don't think that gentleman from the Franklin Institute has been down under there. I have been down in that area, and I have taken quite a few hundred divers down in that area. I don't need anyone to

tell me what that bottom is like—I've been there. That bottom, years ago, used to be a picture like the man showed you here today. I am 63 and I have put plenty of time on that water.

You will not find that same picture, you will find fish that are—I will give you an example; a fisherman, he goes out there with a party, a party fisherman, supposing you had a flounder and all your fish in a bag and then all at once when you are coming home one of your customers yells, "Hey, what's the matter with this fish? He brought out the flounder and it went on the side of the bag as he was bringing it out and the skin and part of the flesh fell off of it. I would say that was pretty sick.

We dug up some stuff in here, in that round section, and there was no living thing except they call it—now, we are not interested in the technology of it, all this malarkey—they tell you, some of them, that the Continental Shelf is not the place. And the place from Philadelphia, you people from Delaware might like it, dump it on your beach, I think it would be wonderful; and also dump it on New Jersey, we've got a ball. We are trying to keep it from happening and if it wasn't for Mr. Shoffler and myself, in September, you people would not be making a meeting here today.

Senator Boggs, there is nothing personal in my attitude if I sound belligerent to you, but I want you to see the point I'm trying to make. Suppose you were sick and I was your doctor. You came to me full of pain and I think "I'll fix him up, get rid of the pain and keep him quiet." I give you the needle, you lose your pain and now feel pretty good. But after the needle wears off you still have whatever it was that gave you the pain. I didn't cure you, I just made you feel good for a while. I'm sure you would want the cure, not just the temporary relief.

I spent some time in Washington with Congressman Sandman—and I am not Democrat or Republican—but what I have learned, and I am coming back to this, it is that the fault belongs to everybody because there is a lack of communication between our elected officials and the people; they don't tell you a damn thing and you people would not have known a thing if we hadn't gone to the greatest expense, privately and through SODA. We tried through SODA, to get this across to the public—Stop Ocean Dumping Association.

But for all the technology we have and all the newfound knowledge, we have got a stinking ocean, that is our No. 1 worry. We sometimes feel they don't know a damned thing about the problems or otherwise we wouldn't still have this rotten ocean. We know it takes time to solve a problem like this but why don't they stop dumping over the Continental Shelf? Why don't they accept petitions signed by 62,000? These people who signed the petitions are not stupid. Our demand is that dumping on the Continental Shelf be prohibited—dump past the shelf instead. As of now it is being dumped in 60 to 70 feet of water on top of the shelf. Over the shelf would be 7,000 to 8,000 feet of water. Thank God we have college kids today, and high school kids, that got more on the ball than their parents, so to speak. I mean, they are not the stone throwers or the brick throwers. They are willing to work for good causes and have the intelligence and courage needed.

Regardless what this gentleman has just said, we don't want it on the Continental Shelf. We know what is being dumped and we know

when the dumping is done in prohibited areas. Some fishermen have told us that the ocean turns black for miles, including the prohibited areas when some dumping is done. This is carried on to pollute the estuaries which are the places where these fishermen have been fishing all their lives. To give you an idea of the seriousness of our claim—material that was to be dumped, from Pennsylvania, and would have been if it were not for Senator Sandman and a group from S.O.D.A. They would have dumped 80,000 pounds of acid that would not dilute with salt water. This material being mixed with $3\frac{1}{2}$ million gallons of residue from a defunct chemical plant. To check this out four of our people from S.O.D.A. who wanted to verify the acid content were literally thrown off for trespassing, with the police after us. They would not give us a chance to verify the tests as to their claims.

Thanks to Congressman Sandman and his efforts, they took the acid far out and dumped in 7,800 feet of water as compared to the 120-foot depth where they were originally going to dump.

One fisherman alone claims he has been fishing 40 years. I would say he knows something about his livelihood—he is not on relief, he's a worker. He claims that in 1930, it took one-tenth of the traps to produce the same amount of fish taken now.

The mussels and the clams in this particular—I am deviating a little to save time—the mussels and the clams that come out of this area are completely dead. This statement is made by a man who fishes for a living, and I will take his statement any day over many of these people who have the degrees.

You have seen pictures of the worthless crabs. This has caused many of the pot fishermen to give up their livelihood. Shipping expenses and cost of supplies have increased greatly and our production is very far down. Unless this disaster and disgrace is stopped we will be a bunch of ruined States.

At one time there were 23 people out on that ocean working—pot fishing—now there are only two or three. This means 20 some families, and this is only one small, small part of the people who have had their livelihood destroyed.

The dockmen depended on them, the gasoline and the food suppliers all depended on these men to make a living, and right now the draggers are off of this section completely. The only way they can make it is to buy sophisticated electronic equipment costing tens of thousands of dollars to make a living where years ago they could do it with a rowboat. And yet these men tell you that there is no harm done in this.

Don't you believe that there is no short dumping. Don't let anybody tell you that they are not short dumping. These fishermen who work there, four or five of them will tell you that they have seen them short dumping.

We stopped them putting 80,000 pounds of acid that could not dilute in salt water, and $3\frac{1}{2}$ million gallons of oil that they were going to dump in the Delaware; and if it wasn't for this gentleman and myself and SODA, who were literally thrown off their property or be locked up and all we wanted to do was to make a test. Somebody lied, they wouldn't give us a chance to make a test.

So the point I am getting at, if it wasn't for people like us getting together you people would not be here today, and the point I want

to make—and I am going to leave here shortly—is to the people out behind me here; if they are going to sit on their butts and do nothing, you people are not going to know anything about it.

In spite of all the technology we have, I would suggest that you develop legislation with the people who are actually in the field. They may make mistakes, but I think they should be on your panel. The people who have the dirt in their fingernails. It may sound awful square, but the kind of legislation you make will be solid and at least have the real voice of the people who are involved, and don't you ever forget it.

Now, I don't want to appear belligerent, but this is a known fact, people are not always cooperative and helpful with the people they elect; they expect you to do a lot but they don't always turn out to help their own cause. I am certainly surprised that no one—our Congressmen, Senators, Governors, and mayors did not know the magnitude of the problem. This man, whose story I have told you, came to me actually alarmed, he has got a mortgage on his boat that has to be paid, and other fixed expenses.

So the point I am trying to get across, and I might sound a little burned-up—which I am—I expected the different Senators to be here to hear this personally. There is a difference to when you hear something and when you read it.

We certainly were very much pleased with Delmarva Penn. to air the situation, and we must compliment them as they are go-getters, and I hope for all humanity sake this ocean dumping is stopped.

As an alternate suggestion it has come to my attention that there are several boats which can make the trip over the Continental Shelf in 16 hours each way, this costing practically the same as the barges, carrying three times as much material.

I could go on more but I don't have the time, I have got to catch the ferry and, again, thank you, and people from Delaware, so help me, you little people in the small towns like this, I have got to compliment them, they are really go-getters and I hope they would force this thing a little bit further.

I would like to go on further but I have got to go.

Senator Boggs. Captain, may I say that the committee wants to salute you and your associates in SODA for the work you have done. It is outstanding. Before we came here today we were well aware of it and the tremendous effort by Congressman Sandman and others, including the two Senators from the State of New Jersey. We seek to resolve the problem with some effective legislation.

I can only say, on behalf of the committee, that we thank you and salute you and SODA for the important work you have done. We value your views and your testimony.

Captain STOCKER. One thing more Senator, I heard a man say that apparently it is going to wash in from the Continental Shelf. What do you think will happen here? Your normal bottom current is swinging in toward shore. There is a heck of a lot of difference between 60 and 70 feet of water against 7 or close to 8, thousand feet of water. It is completely different. As you get over the shelf there is a tendency for that current to swing offshore rather than inshore. If you get a storm, you people in Delaware will find it on your beaches, and it is too late then, regardless what they say in Philadelphia. Just because

it costs them money. I feel for them, and it may cost them a lot and it may put some people out of work, but what is it going to do to us. This is the thing we want to work together on and I think a little more cooperation is needed.

Senator BOGGS. Your testimony has been very useful. I have four questions I had intended to ask, but you have covered the points in your statement.

I am sorry that you have to go; I know you have to catch that ferry. If you have any further views that you or your associates may wish to present, please send them to us.

Captain STOCKER. Just one more thing; I went down to the Rivers and Harbors convention in 1958. I spent a couple days down there, but one Senator, and I won't mention the name because I don't want to make it ugly, there were two ladies testifying who had helped cleanup part of Lake Erie. I think they did a beautiful job. But before they got going they were ridiculed by the town people to the extent that they were forced to get some kind of court order to assist them. And finally there was a younger woman got together with them and they did get that part of the river clean; but this Congressman made a remark that the ecologists, so to speak, are a pain in the neck. As far as the name goes, I am not interested in that. If people like ourselves—I think they call us ecologists—weren't interested enough, you people wouldn't be doing this today. I am sure you wouldn't.

Senator BOGGS. Thank you very much. [Applause.]

Captain NIBLETT. Our next panel member is Clarence Shoffler; he was formerly a pot fisherman, commercial fisherman. He had to quit that on account of fish being so scarce and now he is in the clamming business. So I will turn it over to Clarence.

Senator BOGGS. Captain, where do you clam? Are you an ocean clammer?

Captain SHOFFLER. Yes, sir. In this particular area before the ban and now along the beach.

I have submitted two or three letters from two or three people in the fishing industry.

Senator BOGGS. We have those and they will be made a part of the record.

(Exhibits supplied by Captain Shoffler, and others, appear in the Appendix.)

Captain SHOFFLER. I, myself, have 25 years in the business. This particular area was established 10 years ago.

Senator BOGGS. This area here?—

Captain SHOFFLER. Yes, and I notice here Dr. Erb, and I am not going to try and go through everything that was covered in this but Dr. Ebb stated about his bearings and things, I notice he has only one station in the dump site. The next stations are over 2 miles away from the dump site. There is only one of the stations, this particular station is up in 45 to 50 feet and naturally you would find some life on this top.

Incidentally, I am the one that took the bearings, put these boats on station for Dr. MacDonald and I know with 25 years experience that I am right. Incidentally, where this was taken was in 70 feet of water, this sludge.

Senator BOGGS. Let me interrupt you, Captain. Are you on the bus with the SODA people?

Captain SHOFFLER. Yes, sir, I am, but I told SODA to go ahead because I came over here to say something and I am going to say it. [Applause.]

Senator Boggs. Thank you.

I have been asked to announce that if there is anybody else scheduled to catch the ferry, the bus is out front, ready to leave right now.

Go ahead, Captain.

Captain SHOFFLER. As to Dr. Erb's report—no offense if you are still here—he stated scientists coming out 10 years ago, this is not true. These scientists came out 4 years ago by Dr. Haskins of the University of Rutgers, which is also in this report, and he took soundings of this area, hydrographic area of the sea currents running into the bay up around Cape May Point, coming back down along the Delaware Bay, or Delaware shore.

Dr. Jack Pierce of the Sandy Hook Marine Laboratory—I have his manuscript here which is not quite finished—has found the same thing existing there that are happening right here. These seabed drifters are released, when I first come out about this ocean dumping, these things struck my mind in the New York bight, these seabed drifters released in the same area or the same principle thing in the New York bight, wound up in Sandy Hook. This is the biggest part of them. The same thing holds true here and it is backed up by Dr. Erb.

Now, if this isn't coming inshore, where is it going? This sludge is supposed to go on the bottom. It has a tendency to be buoyant. Most of the sludge that does sink has oil bases and your heavy metal compounds which wind up in your deep water sluice. This is where I took those clam boats with Dr. MacDonald and we got that sewage sludge. It is H_2S , hydrogen, two parts sulfide, lack of oxygen; this is what it is.

Now, nobody in their right mind is going to tell me or anybody else that this isn't killing the bottom.

This particular stuff that Dr. Erb has here is one microsecond, one microsecond outside of the center of the dump site. The center of the dump site is this far off in 65 or 70 foot of water.

As far as the city of Philadelphia, when they talk about 90 percent treated sewage, or treated sludge, I am not guessing, this would make up about 400,000 people dumping in a 1 by 2 mile area in the ocean completely undigested. This doesn't include Camden or Bridgeton which is only a small matter; Bridgeton itself is only about 19,000 and Camden is 75,000, that is untreated. This is 400,000 from the city of Philadelphia. Now, I would like to see that put in a one by two cornfield and grow 45 bushels an acre.

So here is the report and any time that Dr. Erb would like any information, I would be glad to give it to him.

Senator Boggs. Is that report available for the record?

Captain SHOFFLER. This report, no, this is my own personal thing and this isn't a finished report and I wouldn't want to give it to anyone but I will let anyone look at it but I wouldn't want to put it on report.

Senator Boggs. Have you given us the other things to which you referred so they can be made part of the record?

Captain SHOFFLER. I submitted a thing that looks like this, it has the chart on the front, it has two or three letters in there and a few other statements.

Senator Boggs. We have that material.

Thank you very much, Captain. We value your testimony very much. We appreciate your initiative and the work you have done on this important subject. It is going to be very helpful, I am certain.

Captain NIBLETT. Senator, I thought this man here would be very, very valuable to you because he used to make his living fishing and then he went to clamming and it looks like he is going to have a little trouble making a living clamming, especially in this area.

Senator Boggs. You are not allowed to get clams from this area?

Captain NIBLETT. No, he has got to go outside of the district.

Senator Boggs. Does he go farther out?

Captain SHOFFLER. We go farther out and up toward Atlantic City.

Senator Boggs. You go up this way?

Captain SHOFFLER. Yes; and go farther out.

Senator Boggs. Farther out?

Captain NIBLETT. Farther out from this particular site; yes, sir. This ground that is restricted is 120 square miles. This was at one time 70 percent clam high (?); out of this 70 percent was 40 percent sea clam high, which, in the last 20 years, has reproduced about five or six times.

Senator Boggs. Thank you.

Captain NIBLETT. Now, I will give my testimony, it consists of the area about 6 miles south of the dumping ground and within a depth of about 65 feet—right down in there—that is the area that I am familiar with there, that is what I am going to testify.

Senator Boggs. Do you clam there?

Captain NIBLETT. No; fishing.

Senator Boggs. What is the depth there?

Captain NIBLETT. Anywhere from 60 to 90 feet.

The Indian River Captains' Association is an organization of approximately 75 charter boat captains.

Senator Boggs. What are those grounds called?

Captain NIBLETT. The Old Grounds.

Senator Boggs. I have been there.

Captain SHOFFLER. The Old Grounds is up against the Delaware beach more, just inside toward the Delaware beach is deep water.

Captain NIBLETT. We are 75 boat captains located 6 miles south of Rehoboth Beach. The captains charter boats for trolling or bottom fishing.

Indian River Inlet is located 12 miles inshore from what used to be the best fishing grounds on the east coast of the United States, known by fishermen up and down the coast as the "Old Grounds," truly a fisherman's paradise.

I started operating a charter boat from there in the late 1940's. For many years you could go out there with a party of six or eight people and fish for 4 to 6 hours and have a catch of 200 to 400 black bass. During these years the boats were all busy. Thousands of people would come from all parts of the eastern United States to enjoy this extremely good bottom fishing.

In the past 3 years our bass fishing has diminished to practically nothing. Last year we were lucky to catch 30 or 40 bass with a party of eight persons and when a small catch like that was hard to make you would have to move back over a little spot where you caught two or

three fish. You couldn't drift for only about 10 minutes and have to run back over the spot again. Previously we could go out to the Old Grounds, also called the Bass Grounds, and make one or two drifts in 5 or 6 hours fishing and catch fish anywhere in the area, which is about 6 miles south of the dumping area, approximately 4 miles wide and continuing south on down the coast past Delaware, Maryland, and Virginia. Boats from Maryland and Virginia also enjoyed this excellent bass fishing. Not only sport fishing boats used this area; many commercial fishermen made their living here also, but many have quit in the last 3 years, many like this man next to me.

This area has a nice, rough, rocky bottom that attracted the crabs and lobster and other marine life for the fish to live on. Coral used to grow out of these rocks and it looked like a tree limb coming right out of the rock and was a deep orange color. Last year every piece of rock we pulled up off the bottom with our hooks that we brought to the surface, the coral was dead and brown in color.

The part of this area that I am familiar with is 6 miles south of the dumping spot for about 12 miles south. The party boats on down the coast out of Ocean City, Md., have also complained of the scarcity of black bass.

The fishermen in this area were not aware that the Corps of Engineers had given permission for this dumping. This is very unfortunate because we could have had some inspections made periodically of the ocean bottom and found out that this sludge was killing the marine life and could have realized soon what was happening to our fish and could have done something about it 3 or 4 years ago.

We urge you, Senators, to pass legislation to stop ocean dumping to at least 100 miles offshore.

I thank you.

Senator Boggs. Thank you very much.

Why do they call it the Old Grounds?

Captain NIBLETT. I really don't know but it is an old, longtime fishing grounds, ever since I was a boy, and it was always good bass fishing there. You could go out and get, I said two to four hundred bass, we have caught as many as six hundred many days out there, but I just didn't want to go to extremes. But that used to be the fishing paradise.

Senator Boggs. I know.

Captain NIBLETT. But the last year we couldn't catch anything, or just a very few.

Senator Boggs. Do you link that to the dumping?

Captain NIBLETT. Evidently, that is the only thing I can think of. The marine life has died down there, the coral has died down through there, gorgonia is the particular name of it, and it has died all down through that section there and worms and small crabs and lobsters and all used to go in among this vegetation and the fish feed on this.

Senator Boggs. Do you have anyone else wishing to testify?

Captain NIBLETT. This is Captain Mac Simpson of the Ocean City Marlin Club.

Captain SIMPSON. I am afraid I am no longer a captain, I quit the water.

Senator Boggs. Captain, we are glad to have you here.

Captain SIMPSON. I base my very simple testimony on 25 years of being an active waterman, and also my family goes back two hun-

dredged in some years in the fishing business. My father went bankrupt in the fishing business in the fifties due to the scarcity or lack of produce being available.

White marlin fishing in the waters offshore of Ocean City, Md., has been so successful in the past 35 years that Ocean City is now known as the White Marlin Capital of the World.

The value of this sport fishing industry in dollars and cents to Ocean City, Md., and the surrounding area, is extensive. Perhaps even more important is the human enjoyment and recreation that these wonderful game fish provide.

Until 1968, boats fishing from Ocean City, Md., made approximately 95 percent of their white marlin catches within a radius of 35 miles off Ocean City.

During the past three fishing seasons the Ocean City sport fishing fleet has had to run to the continental shelf to find the schools of marlin. This means that the boats are traveling distances of 40 to 70 miles offshore.

I believe that pollution of the tidal waters and now the ocean itself is pushing the white marlin offshore. I also believe this pollution will eventually destroy the sport fishing industry and commercial seafood industries along our coasts.

To support these beliefs I will list some personal observations:

1. The decline and disappearance of the commercial ocean fish traps.
2. The appearance of horribly discolored water attributable only to the hand of man.
3. The rapid disappearance of huge schools of bait-fish and flocks of birdlife from inshore waters.
4. The infrequent sightings of mile-long schools of porpoises along the beaches.
5. The decline of bottom feeding species; and,
6. The disappearance of the croaker from our area.

I propose that the constant and ever-increasing pollution of our waters, particularly the ocean dumping, is mainly responsible for the conditions I have described.

I also propose that it is the duty of every citizen, and every representative of the people, to stop pollution of our waters, whatever the cost, for in the long run it will undoubtedly cost us more than money.

And it seems in addition to this prepared statement I would like to say it seems that anything and everything is conditioned to the dollar and I don't believe that we are going to make much progress until everybody realizes that we are in for more than just loss of our dollars and cents, we are in for the loss of our life as we know it unless something is done and done quickly.

When a body of water the size of the Atlantic Ocean begins to show itself, and it began to show this 20 and 30 years ago, those of us who have worked on the water all our lives have seen these conditions change. I have no scientific data to back it up but I have seen these changes, and as these changes have taken place the people who have worked on the water along the coastline have been driven off, driven off to other sources of income.

There are no more commercial fish traps. It is a matter of record that within the past 15 to 20 years 85 to 90 percent of the commercial fish traps have been driven off the coast.

immediate coastal area. I am not speaking of the open ocean commercial industry but along the coastline, and unless we have legislation to stop this ocean dumping and to clean up pollution entirely, the tidal waters and the ocean, we will see the last of the life as we, our generation, know it, our children will see a much different situation than we have known.

Thank you, sir.

Senator Boggs. Thank you very much. [Applause.]

We appreciate the value of your experience and testimony.

Captain DEFOE. Just one statement, sir.

The Delaware Underwater Swim Club, which is affiliated with the Underwater Council of America, we feel that the water here on the breakwater is so bad for our competitive free diving, that this year we are holding our dives at Point Judith, R.I. That is how bad the water visibility is here.

Senator Boggs. Do you link that fact with the dumping?

Captain DEFOE. Yes, sir; I do.

Senator Boggs. Well, gentlemen, we thank you very, very much for your contribution. I can't think of any group more helpful to our committee than your panel.

Thank you very much, gentlemen.

We now have a panel of seafood processors headed by Warren Lund. I don't know whether Mr. Lund is here or not. He is from Cape May. I don't know if Mr. Lamonica could stay or not as he is also from Cape May.

If they have statements available, we will make them a part of the record.

Our concluding panel is on the subject of tourism. Mr. David Hugg, president of the Rehoboth Beach Chamber of Commerce; a gentleman from Wildwood who may have had to leave; Mr. Robert Gibbs, president of the Lewes Chamber of Commerce, Mr. Ronald Engle, president of the Ocean City Chamber of Commerce, and Mr. Rodia, president of the Ocean Highway Association, Cape May.

STATEMENT OF DAVID S. HUGG, PRESIDENT OF THE REHOBOTH BEACH CHAMBER OF COMMERCE

Mr. HUGG. Mr. Chairman, we have a change in our batting order; Mr. Harry Lozour from the Greater Cape May Chamber of Commerce.

Senator Boggs. Mr. Hugg, will you and your associates please proceed.

Without objection, I will make as a part of the record a proposal by Mr. H. P. Englehardt proposing the barging of waste beyond the Continental Shelf. This looks like a very thorough study.

Here is a statement to be made a part of the record. From the Cannery, Food Processing and Meat and Poultry Workers Union, Local 199, AFL-CIO, which represents, 3,400 members of the Delmarva Peninsula. Mr. Jack Bird, president and educational director of Local 199, was here earlier today.

We also have some statistics, which will be made a part of the record, on tourism in the area.

Mr. Leonard Burton, a seafood processor and the vice-president of the Delmarva Advisory Council, had hoped to be on this panel this afternoon. But he could only stay for the morning session, and regrets

very deeply that he was unable to stay for the balance of the hearing.

Mr. Hugg, I want to thank you, the chamber, and all your associates, including the mayor and council, for your hospitality and your kindness in making the arrangements for the hearing today. We are looking forward to your views on tourism as it may be affected by ocean dumping. As I stated before, anyone who couldn't stay may submit testimony to the committee until the 9th of April.

Mr. Hugg. Mr. Chairman, I would be remiss as president of the chamber of commerce if I didn't say again, as was said earlier today, how pleased we were that you selected the Nation's summer capitol as the site for this hearing.

I have the honor today of speaking for the chambers of commerce and other trades and tourism promotional organizations of the resort communities of southern New Jersey, Delaware, and Maryland.

I might add at this point that a number of those people were here earlier in the day and for various reasons had to leave. As a result Mr. Robert Gibbs of the Lewes Chamber of Commerce will be speaking, we hope, for approximately 14 various organizations who have indicated that their beliefs are similar to ours.

The economy of the communities we represent is largely, directly or indirectly, upon public use of our beaches and coastal waters. This economy, we contend, is today menaced by the presence just a short distance off our shores of a sludge dumping area.

While it is impossible to place an actual evaluation on the economic benefit derived from the annual influx of tourists, vacationists and others, to the coastal lands of southern New Jersey, Delaware and Maryland, it is assumed that revenue directly received by the business communities of such areas is at least \$5 million per year. This figure, incidentally, is one furnished me by a member of your committee and it is our belief it is a very, very conservative estimate.

The tourist dollar, as we all know, in time goes through many hands providing income not only for those operating tourist facilities but, in turn, to many suppliers, manufacturers, industrial workers and the farmer. Some of these latter groups may, of course, be many miles from our seashore communities.

Government, at all levels, participates in the division of the tourist dollar, through taxes and other levies, direct and indirect.

All of this is threatened by the existing deposits of sludge, partially treated sewage, just a few miles off our coasts.

Recent on-the-spot examination of this offshore dumping by representatives of Federal and State environmental control agencies and others whose expertise we recognize and respect, have served to convince us that the area is contaminated and virtually bereft of healthy, living marine life. What these and others have found in the dumping area has served to frighten us and members of the communities represented by our organizations.

Various studies of current patterns in the offshore waters separating our beaches and the sludge dumping area have served to convince us that any sudden change brought on by certain types of offshore origin storms could very well inundate our shorelines with the same foul-smelling toxic substances found on the bottom of the present offshore dumping area. This substance, comprising the residue of partially treated sewage, dead and decaying vegetation, and various forms of

other marine life obviously killed by the polluted water, would, if deposited on our shores create a serious menace to the health and well-being of all those who use our beaches and offshore waters.

We believe it most probable that a northeaster—I think you are familiar with that term, Mr. Chairman—of several days duration would churn up the bottom of this contaminated area sufficiently to deposit this vile smelling, health menacing filth on Delaware and Maryland beaches. Similar effects would likely be experienced by southern New Jersey beaches if northbound storms should pass through the sludge dumping area.

During the past 12 months there have been several occasions when various of our beaches have had cast upon them, during and after offshore storms, foul smelling materials possibly from the offshore dumping area.

Last April, Delmarva beaches, including the one less than three blocks from this meeting place, were covered with a greenish, foul-smelling foam. The exact composition of this foul-smelling mess was never disclosed although tests were presumably made of it. Fortunately, an unusually high tide later flushed away this smelly, unsightly mess.

It is our contention that any future repeat of the great storm of March, 1962, would cast up and leave upon the beaches and on the public and private premises of our resort communities, a mess of foul smelling filth that would pose a great health menace at that time and for an undeterminable period following. The presence of such material could conceivably create a contagion of serious proportions.

The presence at any time on our beaches of residue from the sludge now being dumped a few miles away, would almost immediately be reflected in the economy of the affected resort or resorts. Continued presence of such material would adversely affect the economy not only of the immediate area but the future tax dollar yield to all echelons of government.

Continued presence of sludge on our beaches, in the surf and in the water areas just beyond the surf lines would convert our resorts from communities now deriving millions of dollars from vacationists and other visitors' use of the beaches and waters to disaster areas that would soon acquire the appearance of ghost towns.

Gentlemen, we, the representatives of chambers of commerce and other tourist promotional organizations of the more than one dozen resort communities of southern New Jersey, Delaware and Maryland that are today menaced by the presence off our shores of large deposits of sludge implore you, upon your return to Washington, to immediately seek and find legal means of stopping for all time the present practice of the cities of Philadelphia, Camden and Bridgeton of dumping their partially treated human waste off our coasts.

We feel that a Nation that possesses the expertise and resources to send men to the moon must certainly have the means and the know-how to eliminate the presence of gigantic cesspool just short distances off its ocean beaches.

These waters were provided by a benevolent Creator to provide food and pleasure for the people.

Senator Boggs. Thank you, Mr. Hugg. That was a very fine statement.

Mr. HUGG. I would like at this time to present Mr. Robert Gibbs, Lewes Chamber of Commerce.

(Subsequent to the hearing the following information was submitted for the record:)

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
Washington, D.C.

Mr. DAVID S. HUGG,
President, Rehoboth Beach Chamber of Commerce,
Rehoboth Beach, Del.

DEAR MR. HUGG: On behalf of the Subcommittee on Air and Water Pollution, I wish to thank you for your useful contribution to our hearing on ocean dumping at Rehoboth Beach, Delaware.

In order to complete the hearing record, certain additional information would be helpful to clarify points made during testimony. Would you kindly supply us with written replies to the questions listed below at your earliest convenience?

Thank you for your cooperation.

Sincerely,

EDMUND S. MUSKIE, U.S. Senator,
Chairman, Subcommittee on Air and Water Pollution.

Enclosure.

Question. You mentioned a "greenish mass" washing up on the beaches which "presumably" has been tested and analyzed. Could you supply us with any information on who analyzed this and what the results were? Is anything known of its origin?

(The following answer has been supplied by the Department of Natural Resources and Environmental Control, State of Delaware:)

This greenish foam has appeared two years in succession during the spring months and predominantly in the vicinity of Rehoboth Beach. Chemical analyses of the sample confirmed that the foam was *not* caused by detergents (Methylene Blue Active Substance Test—Standard Methods). Visual examination through a powerful microscope revealed that the green color was due to the presence of plant detritus. It was not possible to identify the origin of such detritus because the plant material was highly broken up. The foam disappeared after a few days. The sudden appearance and disappearance of the foam is certainly puzzling and we do not know the reasons at this time.

N. C. VASUKI,
Manager, Water Resources Section.

Senator Boggs. Mr. Gibbs, we are delighted to have you here today.

STATEMENT OF ROBERT GIBBS, LEWES CHAMBER OF COMMERCE

Mr. GIBBS. Thank you, Senator.

We have prepared a very brief statement and I would like to read it.

The business community of Lewes, a city which receives a substantial income from summer visitors and tourists, is concerned with anything which might adversely affect this phase of our economy.

We are, however, not technically competent to evaluate the effects on our waters of offshore dumping of sewage and industrial wastes.

We can only state that, if in the opinion of experts, this form of waste disposal could, present any hazard to our shores, we would be greatly concerned and would

Senator Boggs. Thank you, Mr. Gibbs. Thank you both. We appreciate your fine statements on behalf of your great organizations and your communities.

That concludes the list of scheduled witnesses. We have a few more minutes. If there is anyone else who has a statement to make or a brief observation, we will be glad to hear you. If Mr. Howard H. Seymour of Lewes, representing the Delmarva Artificial Reef Association, is present, we would be glad to hear from you. I know he is a student of this problem. We received a letter from him and I had hoped that we could hear from him. In any event, we will place his views in the record.

If there are no further witnesses to be heard at this time, I have some material to put in the record. We have a letter to the committee from the officers and directors of the Delmarva Artificial Reef Association, which will be filed.

There is a statement by Mr. Elmer J. Hewitt, international representative, Amalgamated Meat Cutters & Butcher Workmen, AFL-CIO, plus a statement from the county engineer, Mr. William C. Henry of the Sussex County Council.

We also have a statement from a very outstanding Delawarean and citizen of the Rehoboth area who is a lifelong student of water problems, Capt. Charles S. Horn. We are glad to have them.

(See appendix for additional statements.)

If there are no further witnesses, I would like to take this opportunity on behalf of the whole committee to thank all the witnesses. I can assure you that the members who had to leave deeply regret that they couldn't stay for the entire hearing. They will study the record, I am sure. They would want me to thank Mayor Johnson, City Manager Coulter, Police Chief William Marvel and especially Mr. John Brown, the custodian of this fine convention hall, for their fine work in setting up this hearing room and making all of these fine arrangements, which have just been absolutely splendid. The whole committee appreciates your hospitality. We thank the press for being here to cover the hearing because we know the people of the area will be very interested.

As I have said, the hearing record will remain open for any further statements. The committee will continue hearings, not only in Washington but in other parts of the country, on water pollution control legislation. We hope that by the 1st of July the Congress will be able to enact legislation in this very important field.

With these words of thanks, I will adjourn the hearing.

(Whereupon, at 5.30 p.m., Friday, March 26, 1971, the subcommittee recessed, subject to the call of the Chair.)

(Appendix to this day's hearing follows:)

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APPENDIX—MARCH 26, 1971

Senate bill S. 1238, introduced by Senator Boggs of the Air and Water Pollution Subcommittee, and S. 1082, introduced by Senator Clifford Case of New Jersey, follow:

(2177)

92^D CONGRESS
1ST SESSION

S. 1238

IN THE SENATE OF THE UNITED STATES

MARCH 16, 1971

Mr. BOGGS (for himself, Mr. COOPER, Mr. ALLOTT, Mr. BEALL, Mr. BAKER, Mr. BAYH, Mr. BENNETT, Mr. BIBLE, Mr. BUCKLEY, Mr. COTTON, Mr. DOLE, Mr. DOMINICK, Mr. FANNIN, Mr. GOLDWATER, Mr. GURNEY, Mr. HART, Mr. HATFIELD, Mr. HOLLINGS, Mr. HRUSKA, Mr. JAVITS, Mr. JORDAN of Idaho, Mr. MAGNUSON, Mr. MATHIAS, Mr. MUSKIE, Mr. PACKWOOD, Mr. PASTORE, Mr. PEARSON, Mr. PERCY, Mr. PROUTY, Mr. RANDOLPH, Mr. ROTH, Mr. SAXBE, Mr. SCHWEIKER, Mr. SCOTT, Mr. SPONG, Mr. TAFT, Mr. TOWER, and Mr. WEICKER) introduced the following bill; which was read twice and referred to the Committees on Commerce and Public Works jointly

A BILL

To regulate the dumping of material in the oceans, coastal, and other waters, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 *That this Act may be cited as the "Marine Protection Act*
4 *of 1971".*

5 FINDING, POLICY, AND PURPOSE

6 SEC. 2. (a) Unregulated dumping of material into the
7 oceans, coastal, and other waters endangers human health,

II—O

★ (Star Print)

1 welfare, and amenities, and the marine environment, eco-
2 logical systems, and economic potentialities.

3 (b) Congress declares that it is the policy of the United
4 States to regulate the dumping of all types of material in
5 the oceans, coastal, and other waters and to prevent or
6 vigorously limit the dumping into the oceans, coastal, and
7 other waters of any material which could adversely affect
8 human health, welfare, or amenities, or the marine environ-
9 ment, ecological systems, or economic potentialities. To this
10 end, it is the purpose of this Act to regulate the transporta-
11 tion of material from the United States for dumping into the
12 oceans, coastal, and other waters, and the dumping of mate-
13 rial by any person from any source if the dumping occurs in
14 waters over which the United States has jurisdiction.

15 **DEFINITIONS**

16 **SEC. 3.** For the purposes of this Act the term—

17 (a) “Administrator” means the Administrator of the
18 Environmental Protection Agency.

19 (b) “Oceans, coastal, and other waters” means oceans,
20 gulfs, bays, salt water lagoons, salt water harbors, other
21 coastal waters where the tide ebbs and flows, and the Great
22 Lakes.

23 (c) “Material” means matter of any kind or descrip-
24 tion, including, but not limited to, dredge spoil, solid waste,
25 garbage, sewage sludge, munitions, chemical, biological, and

1 radiological warfare agents, radioactive materials, wrecked
2 or discarded equipment, rock, sand, cellar dirt, and industrial
3 waste: *Provided*, That it does not mean oil within the mean-
4 ing of section 11 of the Federal Water Pollution Control
5 Act or sewage from vessels within the meaning of section 13
6 of said Act.

7 (d) "United States" includes the several States, the
8 District of Columbia, the Commonwealth of Puerto Rico, the
9 Canal Zone, the territories and possessions of the United
10 States, and the Trust Territory of the Pacific Islands.

11 (e) "Person" means any private person or entity, any
12 employee, agent, department, agency, or instrumentality of
13 any State or local unit of government, or foreign govern-
14 ment, and, except as to the provisions of section 6, any
15 employee, agent, department, agency, or instrumentality of
16 the Federal Government.

17 (f) "Dumping" means a disposition of material: *Pro-*
18 *vided*, That it does not mean a disposition of any effluent
19 from any outfall structure, or a routine discharge of effluent
20 incidental to the propulsion of vessels: *And provided further*,
21 That it does not mean the intentional placement of any de-
22 vice in the oceans, coastal, or other waters or on the sub-
23 merged land beneath such waters, for the purpose of using
24 such device there to produce an effect attributable to oil
25 than its mere physical presence.

1 (g) "District court of the United States" includes the
2 District Court of Guam, the District Court of the Virgin
3 Islands, the District Court of the Canal Zone, and in the
4 case of American Samoa and the Trust Territory of the
5 Pacific Islands, the District Court of the United States for
6 the District of Hawaii, which court shall have jurisdiction
7 over actions arising therein.

8 PROHIBITED ACTS

9 SEC. 4. Except as such transportation or dumping or
10 both may be authorized in a permit issued by the
11 Administrator—

12 (a) no person shall transport material from the
13 United States for the purpose of dumping it into the
14 oceans, coastal, and other waters, and

15 (b) no person shall dump material (1) in that
16 part of the oceans, coastal, and other waters which is
17 within the territorial jurisdiction of the United States,
18 or, (2), in a zone contiguous to the territorial sea of
19 the United States, extending to a line twelve nautical
20 miles seaward from the base line of the territorial sea
21 as provided in article 24 of the Convention on the
22 Territorial Sea and the Contiguous Zone, to the extent
23 that it may affect the territorial sea or the territory
24 of the United States.

PERMITS

1
2 Sec. 5. (a) The Administrator may issue permits to
3 transport material for dumping into the oceans, coastal, and
4 other waters, or to dump material into the waters described
5 in subsection 4(b), or both, where the applicant presents
6 information respecting the proposed activity which in the
7 judgment of the Administrator indicates that such trans-
8 portation, or dumping, or both will not unreasonably degrade
9 or unreasonably endanger human health, welfare, or ameni-
10 ties, or the marine environment, ecological systems, or eco-
11 nomic potentialities. The Administrator shall establish and
12 apply criteria for reviewing and evaluating such permit ap-
13 plications, and, in establishing or revising such criteria, shall
14 consider, but not be limited in his consideration to, the
15 following:

16 (1) the likely impact of the proposed dumping
17 on human health, welfare, and amenities, and on the
18 marine environment, ~~ecological~~ systems, and economic
19 potentialities, including an assessment of—

20 (A) the possible persistence or permanence
21 of the effects of the proposed dumping,

22 (B) the volume and concentration of materials
23 involved, and

24 (C) the location proposed for the dumping.

25 (2) alternative locations and methods of disposal,

1 including land-based alternatives; the probable impact
2 of requiring the use of such locations or methods of dis-
3 posal on considerations affecting the public interest;
4 and the probable impact of issuing or denying permits
5 on considerations affecting the public interest.

6 In establishing or revising such criteria, the Administrator
7 shall consult with the Secretaries of Commerce, Interior,
8 State, Defense, Agriculture, Health, Education, and Wel-
9 fare, and Transportation, the Atomic Energy Commission,
10 and other appropriate Federal, State, and local officials.
11 With respect to such criteria as may affect the civil works
12 program of the Department of the Army, the Administrator
13 shall also consult with the Secretary of the Army. In re-
14 viewing applications for permits, the Administrator shall
15 make such provision for consultation with interested Fed-
16 eral and State agencies as he deems useful or necessary. No
17 permit shall be issued for a dumping of material which will
18 violate applicable water quality standards.

19 (b) (1) The Administrator may establish and issue
20 various categories of permits, including the general permits
21 described in subsection (e).

22 (2) The Administrator may require an applicant for
23 a permit under subsection (a) to provide such information
24 as the Administrator may consider necessary to review and
25 evaluate such an application.

1 (c) Permits issued under subsection (a) may designate
2 and include (1) the type of material authorized to be trans-
3 ported for dumping or to be dumped; (2) the amount of
4 material authorized to be transported for dumping or to be
5 dumped; (3) the location where such transport for dumping
6 will be terminated or where such dumping will occur; (4)
7 the length of time for which the permits are valid and their
8 expiration date; and (5) such other matters as the Ad-
9 ministrator deems appropriate.

10 (d) The Administrator may prescribe such processing
11 fees for permits and such reporting requirements for actions
12 taken pursuant to permits issued under subsection (a) as he
13 deems appropriate.

14 (e) Notwithstanding any other provision of this Act,
15 the Administrator may issue general permits for the trans-
16 portation for dumping, or dumping, or both, of classes of
17 materials which he determines will have a minimal impact,
18 considering the factors stated in subsection (a).

19 (f) The Administrator may limit or deny the issuance
20 of permits, or may alter or revoke partially or entirely the
21 terms of permits issued by him under this Act, for the trans-
22 portation for dumping, or the dumping, or both, of specified
23 material, where he finds that such material cannot be
24 dumped consistently with the criteria established pursuant to
25 subsection (a). No action shall be taken under this sub-

1 section unless the affected person or permittee shall have
2 been given notice and opportunity for hearing on such
3 action as proposed.

4 (g) The Administrator may, considering the criteria
5 established pursuant to subsection (a), designate recom-
6 mended sites for the dumping of specified materials.

7 (h) Nothing in this Act shall prohibit any transporta-
8 tion for dumping or dumping of material where such trans-
9 portation or dumping is necessary, in an emergency, to safe-
10 guard human life. Such transportation or dumping shall be
11 reported to the Administrator within such times and under
12 such conditions as he may prescribe by regulation.

13 PENALTIES

14 SEC. 6. (a) A person who violates section 4 of this
15 Act, or regulations promulgated under this Act, or a permit
16 issued under this Act by the Administrator shall be liable to
17 a civil penalty of not more than \$50,000 for each violation
18 to be assessed by the Administrator. No penalty shall be
19 assessed until the person charged shall have been given no-
20 tice and an opportunity for a hearing on such violation.
21 Any such civil penalty may be compromised by the Admin-
22 istrator. In determining the amount of the penalty, or the
23 amount agreed upon in compromise, the gravity of the viola-
24 tion and the demonstrated good faith of the person charged
25 in attempting to achieve rapid compliance after notification

1 of a violation shall be considered by said Administrator.
2 Upon failure of the offending party to pay the penalty, the
3 Administrator may request the Attorney General to com-
4 mence an action in the appropriate district court of the United
5 States for such relief as may be appropriate.

6 (b) In addition to any action which may be brought
7 under subsection (a), a person who knowingly and will-
8 fully violates section 4 of this Act, regulations promulgated
9 under this Act, or a permit issued under this Act by the Ad-
10 ministrator shall be fined not more than \$50,000 or im-
11 prisoned for not more than one year, or both.

12 (c) For the purpose of imposing civil penalties and
13 criminal fines under this section, each day of a continuing
14 violation shall constitute a separate offense.

15 (d) The Attorney General or his delegate may bring
16 actions for equitable relief to redress a violation by any per-
17 son of this Act, regulations promulgated under this Act,
18 and permits issued under this Act by the Administrator, and
19 the district courts of the United States shall have jurisdic-
20 tion to grant such relief as the equities of the case may
21 require.

22 (e) A vessel, except a public vessel within the meaning
23 of subsection 13 (a) (3) of the Federal Water Pollution
24 Control Act or other public property of a similar nature,
25 used in a violation shall be liable in rem for any civil penalty

1 assessed or criminal fine imposed and may be proceeded
2 against in any district court of the United States having
3 jurisdiction thereof: *Provided*, That no vessel shall be liable
4 unless it shall appear that the owner was at the time of
5 the violation a consenting party or privy to such violation.

6 (f) If the provisions of any permit issued under sub-
7 section (a) of section 5 are violated, the Administrator may
8 revoke the permit or may suspend the permit for a specified
9 period of time. No permit shall be revoked or suspended
10 unless the permittee shall have been given notice and op-
11 portunity for a hearing on such violation and proposed sus-
12 pension or revocation.

13 RELATIONSHIP TO OTHER LAWS

14 SEC. 7. (a) After the effective date of this Act, all
15 licenses, permits, or authorizations which have been issued
16 by any officer or employee of the United States under
17 authority of any other provision of law shall be terminated
18 and of no effect to the extent they authorize any activity
19 regulated by this Act. Thereafter, except as hereafter pro-
20 vided, no license, permit, or authority shall be issued by any
21 officer or employee of the United States other than the
22 Administrator which would authorize any activity regulated
23 by this Act or the regulations issued hereunder.

24 (b) Nothing in this Act shall abrogate or negate any
25 existing responsibility or authority contained in the Atomic

1 Energy Act of 1954, as amended, and section 4 and sub-
2 section 7 (a) of this Act shall not apply to any activity
3 regulated by that Act: *Provided*, The Atomic Energy Com-
4 mission shall consult with the Administrator prior to issuing
5 a permit to conduct any activity which would otherwise
6 be regulated by this Act. In issuing any such permit, the
7 Atomic Energy Commission shall comply with standards set
8 by the Administrator respecting limits on radiation ex-
9 posures or levels, or concentrations or quantities of radio-
10 active material. In setting such standards for application to
11 the oceans, coastal, and other waters, or for specific portions
12 of such waters, the Administrator shall consider the policy
13 expressed in subsection 2 (b) of this Act and the factors
14 stated in subsections 5 (a) (1) and 5 (a) (2) of this Act.

15 (c) (1) The provisions of subsection (a) shall not
16 apply to actions taken before or after the effective date
17 of this Act under the authority of the Rivers and Harbors
18 Act of 1899. (33 U.S.C. 401 et seq.)

19 (2) Except as provided in subsection 11 (e), nothing
20 in this Act shall be construed as abrogating or negating any
21 existing responsibility or authority contained in the Rivers
22 and Harbors Act of 1899: *Provided*, That after the effective
23 date of this Act, no Federal license or permit shall be issued
24 under the authority of the Rivers and Harbors Act of 1899
25 to conduct any activity otherwise regulated by section 4 of

1 this Act and the regulations issued hereunder, unless the Ad-
2 ministrator has certified that the activity proposed to be
3 conducted is in conformity with the provisions of this Act
4 and with the regulations issued hereunder.

5 (3) Where a license or permit to conduct an activity
6 has been granted under the authority of subsections (c) (1)
7 and (c) (2) of this section and of the Rivers and Harbors
8 Act of 1899, no separate permit to conduct such activity
9 shall be required under this Act.

10 (d) Prior to issuing any permit under this Act, where
11 it appears to the Administrator that the disposition of the
12 material to be transported for dumping or to be dumped
13 may affect navigation in the navigable waters of the United
14 States or may create an artificial island on the Outer Conti-
15 nental Shelf, the Administrator shall consult with the Secre-
16 tary of the Army and no permit shall be issued if the
17 Secretary of the Army determines that navigation will be
18 unreasonably impaired.

19 (e) Nothing in this Act shall be construed as pre-
20 empting any State, Federal territory or Commonwealth,
21 or subdivision thereof from imposing any requirement or
22 liability.

23 ENFORCEMENT

24 SEC. 8. (a) The Administrator may, whenever appro-
25 priate, utilize by agreement, the personnel, services, and facil-

1 ties of other Federal departments, agencies, and instrumen-
2 ties of other Federal departments, agencies, and instrumen-
3 talities or State agencies or instrumentalities, whether on a
4 reimbursable or a nonreimbursable basis.

5 (b) The Administrator may delegate responsibility
6 and authority for reviewing and evaluating permit appli-
7 cations, including the decision as to whether a permit will
8 be issued, to an officer of the Environmental Protection
9 Agency, or he may delegate, by agreement, such responsi-
10 bility and authority to the heads of other Federal depart-
11 ments or agencies, whether on a reimbursable or non-
12 reimbursable basis.

13 (c) The Secretary of the department in which the
14 Coast Guard is operating shall conduct surveillance and
15 other appropriate enforcement activity to prevent unlawful
16 transportation of material for dumping or dumping.

17 REGULATIONS

18 SEC. 9. In carrying out the responsibilities and au-
19 thority conferred by this Act, the Administrator is authorized
20 to issue such regulations as he may deem appropriate.

21 INTERNATIONAL COOPERATION

22 SEC. 10. The Secretary of State, in consultation with
23 the Administrator, shall seek effective international action
24 and cooperation to insure protection of the marine environ-
25 ment, and may for this purpose, formulate, present, or sup-

1 port specific proposals in the United Nations and other com-
2 petent international organization; for the development of
3 appropriate international rules and regulations in support of
4 the policy of this Act.

5 **REPEAL AND SUPERSESION**

6 **SEC. 11.** (a) The second proviso to the last paragraph
7 of section 20 of the Act of March 3, 1899 (30 Stat. 1154),
8 as amended (33 U.S.C. 418), is repealed.

9 (b) Sections 1, 2, 3, 4, 5, 6, and 7 of the Act of
10 June 29, 1888 (25 Stat. 209), as amended (33 U.S.C.
11 441-451b), are repealed.

12 (c) Section 2 of the Act of August 5, 1886 (24 Stat.
13 329) (33 U.S.C. 407a), is repealed.

14 (d) To the extent that it authorizes action regulated
15 by this Act, section 4 of the Act of March 3, 1905 (33 Stat.
16 1147) (33 U.S.C. 419), is superseded.

17 (e) Section 13 of the Rivers and Harbors Act of 1899
18 (30 Stat. 1152), as amended (33 U.S.C. 407), is super-
19 seded insofar as it applies to dumping, as defined in sub-
20 section 3(f) of this Act, of material in the waters covered
21 by subsection 4(b) of this Act.

22 **EFFECTIVE DATE AND SAVINGS PROVISION**

23 **SEC. 12.** (a) This Act shall take effect six months after
24 its enactment.

25 (b) No legal action begun, or right of action accrued,

1 prior to the effective date of this Act shall be affected by any
2 provision of this Act.

3 **AUTHORIZATION FOR APPROPRIATIONS**

4 **SEC. 13.** There is hereby authorized to be appropriated,
5 out of any moneys in the Treasury not otherwise appro-
6 priated, such sums as may be necessary for the purposes and
7 administration of this Act.

92d CONGRESS
1st Session

S. 1082

IN THE SENATE OF THE UNITED STATES

MARCH 2 (legislative day, FEBRUARY 17), 1971

Mr. CASE (for himself, Mr. BOGGS, Mr. GRAVEL, Mr. MUSKIE, Mr. PACKWOOD, and Mr. WILLIAMS) introduced the following bill; which was read twice and referred to the Committees on Commerce and Public Works jointly

A BILL

To regulate the discharge of wastes in territorial and international waters until five years after the date of enactment of this Act, to prohibit such discharge thereafter, and to authorize research and demonstration projects to determine means of using and disposing of such waste.

- 1 *Be it enacted by the Senate and House of Representa-*
- 2 *tives of the United States of America in Congress assembled,*
- 3 That, effective on the date which is five years after the date
- 4 of enactment of this Act, no owner or master of a vessel may
- 5 load, or permit the loading of, any waste on such vessel while
- 6 such vessel is in any port of the United States, if such waste
- 7 is to be discharged in ocean waters. Prior to such date such
- 8 loading shall be lawful only if such owner or master first—

1 (1) obtains a permit from the Administrator of the
2 Environmental Protection Agency (hereafter referred
3 to in this Act as the "Administrator") which authorizes
4 the loading of such waste; and

5 (2) notifies the Coast Guard of such loading as pre-
6 scribed in section 3.

7 SEC. 2. (a) The Administrator shall issue to any owner
8 or master of a vessel a permit authorizing the loading of
9 waste on such vessel if the Administrator finds that the dis-
10 charge of such waste in any ocean waters will not damage
11 the ecology of the marine environment. In making any such
12 finding, the Administrator shall consider the effect of such
13 discharge on human health and welfare (including possible
14 adverse effects on economic, recreational, and esthetic values)
15 and on the marine ecosystem, taking into account the pro-
16 posed location of such discharge and the concentration and
17 volume of the waste to be discharged.

18 (b) In no event shall any permit be issued for the dis-
19 charge of any waste whatever between the Continental Shelf
20 and the coast of the United States.

21 (c) The Administrator shall have the authority to ban
22 the loading, transporting, and dumping of any specific mat-
23 ter deemed damaging to the marine environment or to human
24 health and welfare.

3

1 (d) The Administrator shall have the authority to des-
2 ignate ocean dumping sites.

3 (e) Each permit issued under subsection (a) shall
4 specify—

5 (1) the amount and type of waste authorized to
6 be loaded and discharged;

7 (2) the exact coordinates of the location at which
8 such discharge is permitted and a statement of the route
9 to that location;

10 (3) such provisions as the Administrator deems
11 necessary to insure that such waste will be transported
12 to the discharge site without accidental spillage or leak-
13 age; and

14 (4) such other provisions as the Administrator
15 deems necessary to carry out the purposes of this Act.

16 SEC. 3. (a) Any owner or master of a vessel who is
17 issued a permit under section 2 shall notify the Coast Guard
18 and the Army Corps of Engineers of the exact location
19 where the waste covered by such permit is to be discharged.
20 Such notification must be given to the Coast Guard and the
21 Army Corps of Engineers in such manner as the Secretary
22 of the Department in which the Coast Guard is operating,
23 and the Secretary of the Army, respectively, shall prescribe

1 and not later than four hours before the departure of the
2 vessel.

3 (b) The Secretary of the Department in which the
4 Coast Guard is operating shall conduct surveillance and
5 other appropriate enforcement activity to prevent violations
6 of this Act.

7 SEC. 4. (a) Any owner or master of a vessel who vio-
8 lates the first section of this Act or who violates any pro-
9 vision of a permit issued under section 2 of this Act shall be
10 liable to a civil penalty of not more than \$50,000 for the
11 first violation, and not more than \$100,000 for each sub-
12 sequent violation. No penalty shall be assessed until the
13 person charged shall have been given notice and an oppor-
14 tunity for a public hearing on such charge. Upon failure
15 of an offending party to pay the penalty, the Administrator
16 may request the Attorney General to commence an action
17 in the appropriate district court of the United States for such
18 relief as may be appropriate.

19 (b) A vessel, other than a vessel owned or bargeboat
20 chartered by the United States, or other property used in a
21 violation shall be liable in rem for any civil penalty assessed
22 under this section and may be proceeded against in any dis-
23 trict court of the United States having jurisdiction thereof.

24 SEC. 5. As used in this Act—

25 (1) The term "discharge" means to place, release,

1 discharge, or by any means whatsoever to dispose, of
2 waste in ocean waters.

3 (2) The term "master" includes any person act-
4 ing in the capacity of a master.

5 (3) The term "ocean waters" means any estuarine
6 area, coastal waters, Great Lakes, territorial waters,
7 and the high seas adjacent to the territorial waters.

8 (4) The term "owner" includes any private in-
9 dividual or corporate owner and any public owner,
10 whether a department, agency, or instrumentality of a
11 State or a political subdivision thereof, of an interstate
12 governmental entity, or of the Federal Government.

13 (5) The term "United States" means the States,
14 the District of Columbia, the Commonwealth of Puerto
15 Rico, Guam, and American Samoa.

16 (6) The term "vessel" includes any vessel, scow,
17 or boat, whether or not documented under the laws of
18 the United States, capable of being used to transport
19 waste in ocean waters.

20 (7) The term "waste" means matter of any kind
21 or description, including, but not limited to, dredge
22 spoil, spoil waste, garbage, sewage sludge, munitions,
23 chemical, biological and radiological warfare agents,
24 radioactive materials, wrecked or discarded equipment,
25 rock, sand, cellar dirt, and industrial wastes.

1 SEC. 6. On and after the effective date of this Act, any
2 license, permit, or authorization issued by any officer or
3 employee of the United States under the authority of any
4 other provision of law is terminated and has no effect what-
5 soever to the extent that such license, permit, or authoriza-
6 tion authorizes any activity to which this Act applies.

7 SEC. 7. (a) The Administrator shall conduct, and en-
8 courage, cooperate with, and render financial and other
9 assistance to appropriate public (whether Federal, State,
10 interstate, or local) authorities, agencies, and institutions;
11 private agencies and institutions, and individuals in the
12 conduct of, and promote the coordination of, research, investi-
13 gations, experiments, training, demonstrations, surveys, and
14 studies for the purpose of determining means of recovering
15 useful materials from waste and disposing of waste in a
16 manner that will not endanger the public health or welfare.

17 (b) In carrying out the provisions of the preceding
18 subsection, the Administrator is authorized to—

19 (1) collect and make available, through publica-
20 tions and other appropriate means, the results of, and
21 other information pertaining to, such research and other
22 activities, including appropriate recommendations in con-
23 nection therewith;

24 (2) cooperate with public and private agencies,
25 institutions, and organizations, and with any industries

1 involved, in the preparation and the conduct of such
2 research and other activities; and

3 (3) make grants-in-aid to public or private agencies
4 and institutions and to individuals for research, training
5 projects, surveys, and demonstrations (including con-
6 struction of facilities), and provide for the conduct of
7 research, training, surveys, and demonstrations by con-
8 tract with public or private agencies and institutions and
9 with individuals; and such contracts for research or
10 demonstrations or both (including contracts for con-
11 struction) may be made in accordance with and subject
12 to the limitations provided with respect to research con-
13 tracts of the military departments in title 10, United
14 States Code, section 2353, except that the determination,
15 approval, and certification required thereby shall be
16 made by the Administrator.

17 (c) Any grant, agreement, or contract made or en-
18 tered into under this section shall contain provisions effec-
19 tive to insure that all information, uses, processes, patents,
20 and other developments resulting from any activity under-
21 taken pursuant to such grant, agreement, or contract will
22 be made readily available on fair and equitable terms to
23 industries or persons utilizing methods of waste disposal
24 and industries or persons engaging in furnishing devices,
25 facilities, equipment, and supplies to be used in connection

1 with waste disposal. In carrying out the provisions of this
2 section, the Administrator and each department, agency,
3 and officer of the Federal Government having functions or
4 duties under this Act shall make use of and adhere to the
5 Statement of Government Patent Policy which was promul-
6 gated by the President in his memorandum of October 10,
7 1963. (3 CFR, 1963 Supp., p. 238.)

8 SEC. 8. This Act shall take effect immediately upon
9 enactment.

The following articles from Science, February 13, 1970, and February 19, 1971, were submitted for the record by Senator Eagleton of the subcommittee:

MICROBIAL DEGRADATION OF ORGANIC MATTER IN THE DEEP SEA

ABSTRACT.—Food materials from the sunken and recovered research submarine *Alvin* were found to be in a strikingly well-preserved state after exposure for more than 10 months to deep-sea conditions. Subsequent experiments substantiated this observation and indicated that rates of microbial degradation were 10 to 100 slower in the deep sea than in controls under comparable temperatures.

On 16 October 1968, the research submersible *Alvin* of the Woods Hole Oceanographic Institution sank in about 1540 m of water, 135 miles southeast of Woods Hole, Massachusetts. The accident occurred when, because of a broken cable, the vessel dropped into the sea with an open hatch and sank after the crew of three escaped safely. A photograph taken on 13 June 1969 by U.S.N.S. *Mizar* prior to the retrieval operations showed the position of the vessel on the sea floor, the hatch still being open. On 1 September 1969, *Alvin* was brought to the surface (1). Among the items recovered was the crew's lunch consisting of two thermos bottles filled with bouillon and a plastic box containing sandwiches and apples. From general appearance, taste, smell, consistency, and preliminary bacteriological and biochemical assays, these food materials were strikingly well-preserved. When kept under refrigeration at 3°C, the starchy and proteinaceous materials spoiled in a few weeks.

Possible implications of this unexpected finding led us to make some additional observations. The environmental conditions at a depth of 1500 m are assumed to be fairly constant at about 3° to 4°C and 150 atm of pressure. There was no evidence of reducing conditions nor was there a noticeable lack of dissolved oxygen either in the pressure hull of the vessel or in the box containing the food materials. In addition, there was no evidence for the presence or the possible leakage of a soluble material that could have acted as a preservative. The plastic lids of the stainless steel thermos bottles were crushed by pressure, and some seawater must have penetrated and mixed with the contents.

Besides being soaked with seawater, the six sandwiches wrapped in waxed paper appeared fresh by taste and smell. When pieces of the bread were streaked on seawater agar, bacteria and molds grew profusely. Placed in tubes with sterile seawater and kept at 3° C, the bread decayed with slight gas production (floating to surface) within 6 weeks. The slices of meat (bologna) were grayish on the outside but still pink in the center. Submerged in sterile seawater, the meat spoiled with a putrefactive smell within 4 weeks at 3°C and within 5 days at 30°C.

The two apples found in the lunch box had a pickled appearance but showed no sign of obvious decay. The pH of the tissue was the same pH (3.2), and the tyrosinase activity (2) was about half that of a fresh apple tested. The soup, originally prepared with hot (not boiling) water from canned meat extract, was perfectly palatable in hot and cold condition. Samples of this broth showed a maximum turbidity caused by bacterial growth in 22 days when incubated at 3°C, and in 5 days when incubated at 30°C. Sporeforming bacteria were observed while the majority of bacteria were represented by Gram-negative rods that grew well on sea-water media.

In conclusion, the food materials recovered from *Alvin* after 10 months of exposure to deep-sea conditions exhibited a degree of preservation that, in the case of fruit, equaled that of careful storage and, in the case of starch and proteinaceous materials, appeared to surpass by far that of normal refrigeration.

The implications of this finding, if generally true, are of theoretical and practical interest. Viewing the ocean as the ultimate sink of inorganic as well as organic materials, we have virtually no knowledge of qualitative and quantitative microbial decomposition processes. While the absolute amounts of nonliving organic matter calculated for all oceans by far exceeds that of the landmasses, the actual concentrations in seawater are extremely low. In fact, in the larger

part of the oceans the concentration of dissolved organic carbon is too low for a direct measurement of oxygen consumption or any other parameter as an indicator of degradation processes. The constancy of organic carbon concentrations with depth in the sea suggests little or no microbial activity (3). On the other hand, results of experimental work on the effect of low temperature and high hydrostatic pressure (4) do not exclude considerable microbial activities in the deep sea if suitable energy sources and nutrients are available.

Research in this laboratory has been directed toward measuring *in situ* rates of growth and biochemical activities of marine bacteria as measured by chemostat systems fed with natural seawater (5). This approach has been limited to the richer surface waters. The *Alvin* accident stimulated a direct experimental study of microbial activities as affected by deep-sea conditions.

Various experimental approaches were readily conceivable in order to confirm the observed phenomenon on a more general basis. In cooperation with the Department of Physical Oceanography a program was designed in which specially designed sample racks were attached to deep-sea moorings about 10 m above the sea floor at depths of about 5000 m and recovered by an acoustic release mechanism after exposure for 2 to 5 months.

The sample racks held about 50 bottles of 120-ml volume each and 20 plastic syringes containing liquid media of various types and concentrations. In experiments with ^{14}C -labeled substrates, the bottles were filled with seawater from 200 m collected at the site of launching. The substrates were added just before the samples were submersed. The serum stoppers used for sealing permitted pressure equalization. Parallel controls were kept under refrigeration at 3°C in the laboratory at 1 atm in the dark. In other experiments, bottles were inoculated with mixed microbial populations of heavily contaminated surface water (El Pond, Woods Hole). Some bottles were equipped with a simple device that provided for self-inoculation by hydrostatic pressure at depths from 150 m down to the sea floor. Other samples were inoculated with pure cultures of specific isolates and submerged in plastic syringes of 50-ml volume containing air in addition to the liquid media. The mechanical behavior of the bottles and syringes at increased hydrostatic pressure was tested in special pressure chambers equipped with viewing ports (6).

For the data presented in this account the following brief indication of analytical methods may suffice. ^{14}C -Labeled substrates and metabolic products were counted in a Packard (Tri-Carb, model 3380) scintillation spectrometer in 10 ml of Bray's solution. The efficiency of all counts was corrected for quenching from a prepared external standard ratio curve. Ammonia released from nitrogenous substrates was determined by micro-Kjeldahl distillation. Residual carbohydrates and sugars were determined by the phenol-sulfuric acid method (7). For the determination of bacterial growth, colonies were counted on seawater agar containing the particular substrate studied.

TABLE 1¹

Substrate added ($\mu\text{g.}$)	Substrate in particulate fraction ($\mu\text{g.}$)		Sample control (percent)	Substrate added ($\mu\text{g.}$)	Substrate in particulate fraction ($\mu\text{g.}$)		Sample control (percent)
	Control	Sample			Control	Sample	
Acetate:							
3,600-----	88.9	3.58	3.0	3,600-----	252.5	6.50	1.9
1,200-----	146.1	2.08	1.07	1,200-----	130.6	1.66	.95
600-----	138.7	.29	.15	600-----	59.6	2.20	2.77
240-----	16.2	.073	.34	240-----	43.8	.50	.86
Mannitol:							
3,600-----	166.6	3.45	1.55	3,600-----	406.7	48.80	9.0
1,200-----	46.0	1.06	1.7	1,200-----	336.0	14.40	3.2
600-----	41.1	.60	1.1	600-----	123.6	17.10	10.4
240-----	40.1	.13	.24	240-----	49.9	8.60	12.9

¹ Microbial degradation of 4 substrates exposed for 8 weeks at a depth of 5,300 m. (location 33° 58' N., 70° W.) as compared to controls kept at 3° C. for 6 weeks. Percent values are corrected for the unequal exposure time. The microgram values are calculated from counts of ^{14}C radioactivity and are given for total volume of sample (120 ml.). Cold Difco casamino acids were added to a mixture of 14 uniformly labeled ^{14}C -amino acids. The inoculum consisted of about 120 ml. of sea-water sampled separately at a depth of 200 m. at the site of launching.

Table 1 represents data of an experiment with ^{14}C -labeled substrates in concentrations of 2 to 30 $\mu\text{g./ml.}$ The total recovery of added ^{14}C activity in the three fractions—residual substrate, CO_2 , and particulate carbon—ranged from 95 to 99 percent. The ratio of the amount of labeled CO_2 to the amount of particulate

carbon in the laboratory controls ranged from 1.5 to 3.4. In the deep-sea samples, however, the amount of labeled CO_2 was too small for significant measurements and very low relative to the amount of labeled carbon in the particulate fraction. For this reason, only the data for the conversion of substrate into particulate carbon are given in Table 1. It might be assumed that dissolved products other than CO_2 were formed by fermentative interconversions. However, there was no indication of anaerobic or reducing conditions in any of the samples.

Table 1 shows that the amount of substrate converted into the particulate fraction in the deep-sea samples ranged from 0.15 to 12.9 when expressed as the percentage of the corresponding conversion in the laboratory controls (in the calculation of these percentage figures, the values of columns 2 and 3 have been corrected for the unequal exposure time). In other words, in these two extreme cases the substrate decomposed 666 to 8.2 times more slowly in the deep-sea samples than in the refrigerated laboratory controls. The corresponding average figures for the two carbohydrates are 88 times, and for glutamate and casamino acids 62 and 11 times respectively. With the exception of the casamino acids, these rates appear to decrease with increasing concentration of the particular substrate. In addition, on the basis of the turnover of organic carbon, in the deep-sea samples the carbohydrates decomposed two to four times more slowly than the nitrogenous substrates.

In another experiment at the same location, chemical analyses were used. For the sake of analytical accuracy, the substrate concentrations were chosen to be five to ten times higher (Table 2). The controls were checked after an incubation period of 6 weeks, at which time the degradation was clearly completed. Therefore, the ratios between the amount of substrate utilized in the controls (corrected for an incubation time of 19 weeks) to that metabolized in the deep-sea samples represent maximum values.

TABLE 2¹

Initial concentration ($\mu\text{g./ml.}$)	Change in concentration ($\mu\text{g./ml.}$)		Sample control (percent)	Initial concentration ($\mu\text{g./ml.}$)	Change in concentration ($\mu\text{g./ml.}$)		Sample control (percent)
	Control	Sample			Control	Sample	
Starch: 1,850 ----	1,330	260	6.2	Peptone: 57 -----	263	9	1.1
	1,290	170	4.2		258	20	2.4
Galactose: 1,800..	1,680	220	4.15	Albumin: 57 -----	172	15	2.8
	1,580	280	5.6		173	17	3.1

¹ Microbial degradation of 4 substrates in 50 ml. syringes (10 ml. of liquid medium, 20 ml. of air) exposed for 19 weeks at a depth of 5300 m. (location: 33°58'N. 69°58'W) as compared to controls kept at 3° C for 6 weeks. Percent values are corrected for the unequal exposure time. The substrate concentrations are given as micrograms of starch, galactose, or ammonia nitrogen per milliliter, respectively. The inoculum was 5 ml. of surface water from Eel Pond, Woods Hole.

There was no perceptible quantitative difference in the rates of decomposition per bacterial cell when rich surface water or offshore seawater collected at 200 m was used as an inoculum. In pure culture experiments, we selected mesophilic and psychrophilic strains that had been isolated from various depths in the open ocean. Only an obligately psychrophilic bacterium produced a small but significant amount of ammonia in a peptone-yeast extract medium (Table 3). In no instance did any of the liquid media incubated in the deep sea give rise to turbid cell suspensions.

TABLE 3

Strain:	Temperature range for growth (°C.)	Change in concentration ²		Strain:	Temperature range for growth (°C.)	Change in concentration ²	
		Control	Sample			Control	Sample
44 -----	17-36	3	0.1	20 -----	1-27	128	+4.4
36 -----	8-36	1.5	-7	60 -----	1-23	87	-1
7 -----	1-36	130	-1.1	58 -----	1-17	15	+2.2

¹ Microbial degradation of a complex nitrogenous medium (0.02 percent yeast extract, 0.2 percent peptone, and an initial ammonia nitrogen concentration of 39.0 $\mu\text{g./ml.}$) in 50 ml. syringes (10 ml. of medium, 20 ml. air) exposed for 18 weeks at a depth of 4,300 m. (location: 28°N. 70°W) as compared to controls kept at 3°C. for 6 weeks. The ammonia nitrogen values have a standard deviation of $\pm 0.5 \mu\text{g./ml.}$ The inoculum was 6 strains of mesophilic and psychrophilic bacteria isolated in a preceding study (9).

² Micrograms of ammonia nitrogen per milliliter.

From this study it appears that the degree of preservation of the food materials recovered from *Alvin* is no chance observation, although our experiments were carried out at greater depths than those where the *Alvin* accident occurred.

The surprisingly large difference between rates of degradation in samples exposed to deep-sea conditions and those in controls appears to be real. The data support the notion of a general slow-down of life processes in the deep sea. No obvious explanation is readily conceivable except for some clues derived from an apparent temperature-pressure relation in microorganisms indicated by some of our data.

The experiment with pure cultures (Table 3) included, in addition to typical mesophilic bacteria, several psychrophilic strains that all grew readily at -1°C . (not identical with the minimal growth temperature) in the laboratory. At deep-sea conditions, however, only the culture with the lowest maximal growth temperature (strain 58) caused detectable biochemical changes of the substrate within the given exposure time. But even in this case, the rate is strongly reduced as compared to that in the laboratory controls.

These data suggest that, superimposed on a quantitative reduction of the rate of biochemical activity, the increased hydrostatic pressure may exert an effect on the cells, raising the minimal growth temperature. When this increase exceeds the environmental temperature, the cells will become inactive. This effect would be similar to, but not necessarily biochemically linked to, the observed increase in temperature tolerance of bacteria (4) and of isolated enzymes (8) when exposed to similar increases of pressure.

We now propose the hypothesis that, in an environment of low temperature, an increasing pressure will eliminate growth and biochemical activity of bacterial types successively as their minimal growth temperatures are shifted toward, and ultimately surpass, the environmental temperature. Thus, psychrophilism of our isolates at normal pressure may be defined as an expression of adaptability to the combined effect of high pressure and low temperature. Or, in other words, psychrophilic bacteria would not necessarily react as psychrophiles in the deep sea. Laboratory experiments in this direction are under way.

Our hypothesis may be further supported by the fact that in marine sediments from depths of 1300 and 2600 m extremely obligate psychrophilic bacteria that exhibited maximal growth temperatures between 8° and 15°C . have been isolated. These types are not found in shallower waters where obligate psychrophiles with maximal growth temperatures between 17° to 24°C . are present (9). Strain 58 belongs to the latter group but appears to have the potential of being biochemically active at 2° to 3°C . at a depth of 4300 m.

In seawater collected at a depth of 200 m (17.6°C .), mesophilic bacteria were predominant while obligate psychrophilic bacteria were absent (9). This may explain the low absolute rates of degradation in these samples when exposed to deep-sea conditions.

One obvious implication of our findings concerns the use of the deep sea as a dumping site for organic wastes. The relatively low rates of microbial activity at deep-water conditions appear to render this way of waste disposal very inefficient compared to the degradation of organic wastes in land-disposal sites or in treatment plants. Accumulations of waste materials or intermediate decomposition products in the deep sea appear rather uncontrollable. Bruun and Wolff (10) mention the common recovery of waterlogged wood materials from deep-sea dredgings even far from land.

Normally, few solid organic materials, produced on land or in the sea, can be expected to reach the deep sea without passing surface waters or shallow-water sediments where considerable degradation occurs. If this step during offshore disposal were eliminated, it seems possible to trap substantial amounts of nutrients in solid form in the deep sea, and thereby remove them from natural or technically enhanced recycling processes. The notion of fertilizing the sea with man-made wastes might not be applicable with regard to deep-sea dumping.

Although neither microbial population collected from surface or deep waters showed appreciable activities when exposed to deep-sea conditions, our data do not entirely disprove the possibility of long-term enrichments in deep-sea sediments. Whether or not adaptive processes occur, the rates of oxygen supply and microbial degradation activities will determine the extent to which anaerobic conditions will arise, with possible elimination of the benthic nonmicrobial fauna.

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THE OCEAN: A NATURAL SOURCE OF CARBON MONOXIDE

ABSTRACT.—The surface waters of the western Atlantic are supersaturated with respect to the partial pressure of carbon monoxide in the atmosphere. Under these conditions, the net transport of carbon monoxide across the air-sea interface must be from the sea into the atmosphere. Thus, the ocean appears to act as a source of carbon monoxide. The ocean may be the largest known natural source of this gas, contributing possibly as much as 5 percent of the amount generated by burning of fuels by man.

It is generally agreed that the largest single source of carbon monoxide in the atmosphere is the burning of fuel by man, which at the present time is estimated to produce approximately 2×10^{14} g (200 million tons) per year of this toxic pollutant (1). Several natural sources of carbon monoxide have also been reported (2); however, no estimate of output of these sources is available. Despite a continually increasing rate of input into the atmosphere, the background amount of carbon monoxide in the marine atmosphere far removed from sources of pollution appears to be remaining at approximately 0.1 pp. (1, 3). Efficient mechanisms of removal must therefore exist, but the nature of these processes is not clear (2). In order to determine the possible role of the oceans as a sink for this pollutant, we undertook an investigation of the distribution of carbon monoxide between the atmosphere and surface waters. Preliminary results indicated that the surface waters are supersaturated in carbon monoxide with respect to the partial pressure of this gas in the atmosphere (3). Additional data we now present confirm these findings,

and it now appears that rather than acting as a sink the ocean may indeed be the largest natural source of carbon monoxide now known.

During a recent oceanographic cruise in the Atlantic, two 24-hour stations were occupied at which both air and surface water samples were taken at 2-hour intervals. All samples were collected and analyzed within 1 hour of collection by methods previously described (3). The stations were at 13°13.9'N, 59°07'W (approximately 64 km east of Barbados), and 10°38', 60°05'W (about 112 km east of Trinidad), respectively. At both locations, the prevailing easterly trade winds minimize the possibility of contamination from man-made sources of pollution. The biological characteristics of the water at the two stations, however, differ significantly; the water in the vicinity of the first station is much lower in overall productivity than that at the second station (4).

Two characteristics of the data, (Fig. 1) are evident: (i) the relatively constant concentration of CO in the atmosphere at both locations, and (ii) a marked diurnal effect with respect to concentration of CO in the surface waters. The average atmospheric concentrations of 0.14 ppm and 0.09 ppm at stations 1 and 2, respectively, agree with values previously reported for clean marine air of 0.05 ppm (1), and 0.08 ppm (3). They are also in agreement with an average value of 0.09 ppm (5) for Arctic air. The surface water concentrations of CO showed a greater diurnal effect at station 2, which may possibly be related to the high biological productivity of these waters as compared to station 1. The concentrations of dissolved CO between 10^{-4} and 10^{-5} ml/liter agree with values reported for western Atlantic waters (3), and also with unpublished values of from 1 to 3×10^{-5} ml/liter found by us in the vicinity of the Chesapeake Light Tower, some 24 km from the entrance to Chesapeake Bay. The observed decrease in dissolved CO during the late afternoon and early evening hours appears to be accompanied by a slight but significant increase in atmospheric CO. That the correlation is not more clearly evident is likely due to very rapid mixing in the atmosphere, since the wind velocities during all sampling operations were between 10 and 15 knots.

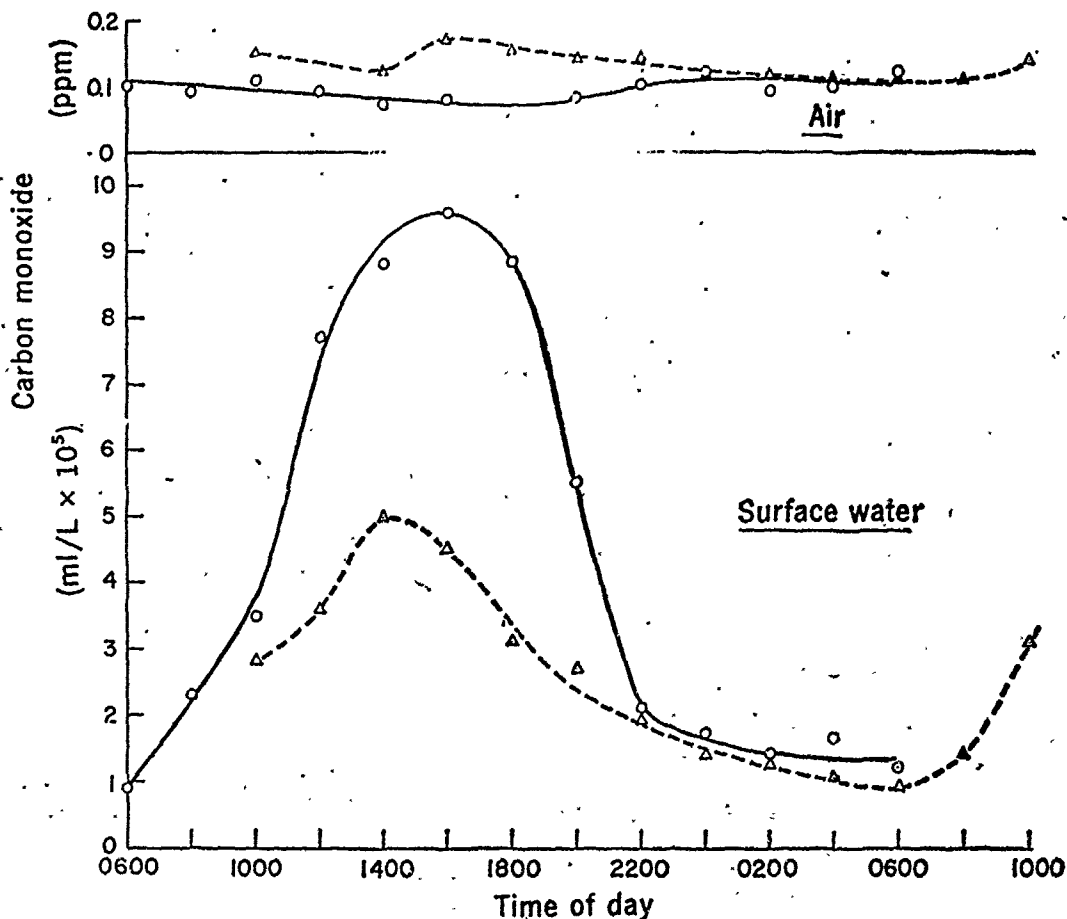


FIGURE 1. Concentration of carbon monoxide in surface waters and in the atmosphere. (Triangles) Station 1, 13°13.9'N, 59°07'W; 18 to 19 April 1969. (Circles) Station 2, 10°38'N, 60°05'W; 21 to 22 April 1969.

A state of nonequilibrium between atmospheric and dissolved CO has been reported based on a comparison of the measured concentrations of dissolved CO with those calculated on the assumption that the atmosphere was the only source of CO (3). This is confirmed by the data we now present (Fig. 2). The ratio, R_{CO} of measured to calculated dissolved CO concentrations, in which the calculated values are obtained by multiplying the measured partial pressures of CO in the atmosphere by the solubility coefficients for CO in seawater as given by Douglas (6), is a measure of departure from equilibrium. Since the value of R_{CO} at equilibrium would be unity, it is apparent that the distribution of CO between atmosphere and surface waters is indeed far from equilibrium, and that the water is in general supersaturated with respect to the partial pressure of CO in the atmosphere. This is true even during the night, when R_{CO} drops to its minimum value of about 5.

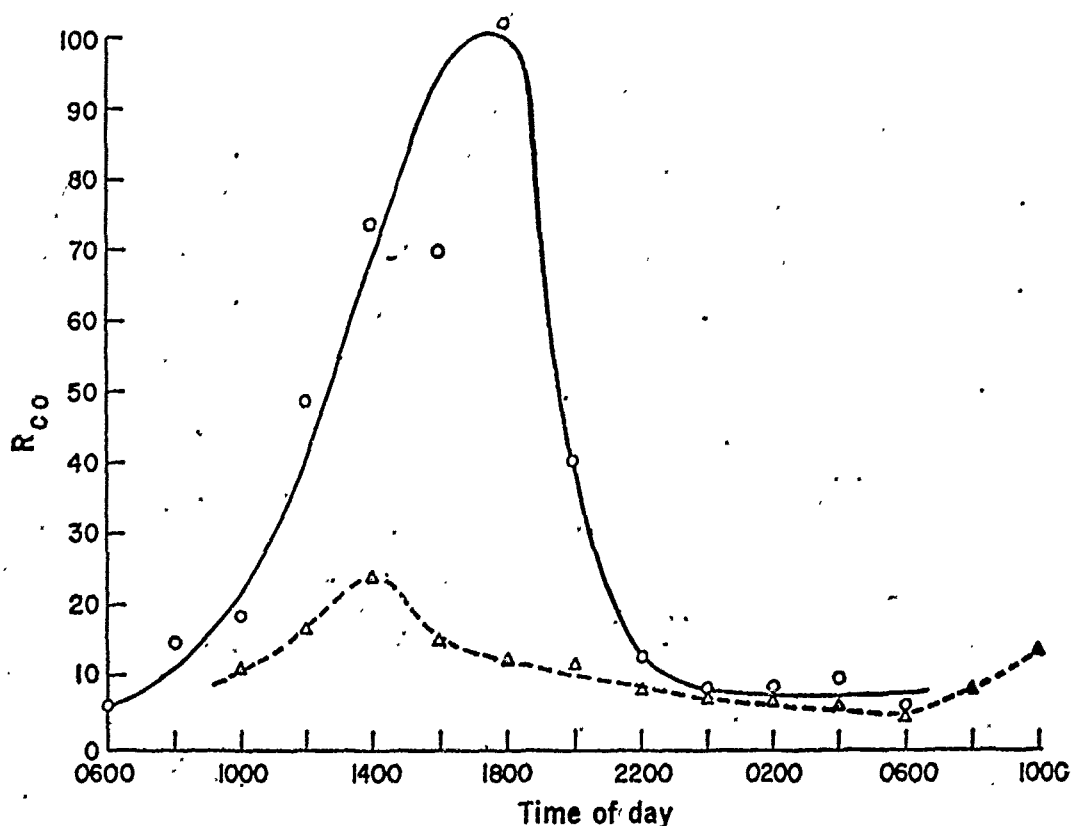


FIGURE 2. Variations during a 24-hour period in the ratio R_{CO} of measured to calculated carbon monoxide concentrations in surface waters. Calculated concentrations based on equilibrium distribution of CO between sea and atmosphere, assuming atmosphere to be sole source of CO. (Triangles) Station 1, $13^{\circ}13.9'N$, $59^{\circ}07'W$; 18 to 19 April 1969. (Circles) Station 2, $10^{\circ}38'N$, $60^{\circ}05'W$; 21 to 22 April 1969.

The source of the excess carbon monoxide found in the seawater is not known. The mechanism of production may be biological in nature; marine algae (7), the Portuguese man-of-war (8), and some siphonophores (9) have been reported to produce carbon monoxide. Biological production would explain the higher peak concentrations found at station 2, in waters of higher productivity. It is also possible that photochemical decomposition of organic matter near the surface is responsible. For example, we observed that weather conditions at station 1 during the sampling operations were generally cloudy and overcast, as contrasted to bright and sunny weather which prevailed at station 2. Further observations are needed to clarify this point.

The supersaturation of the surface waters with respect to the atmospheric partial pressures of CO indicates that the net transport of carbon monoxide across the air-sea interface should be from the water into the atmosphere. Although the absolute concentrations of dissolved CO are low, on a worldwide basis the amount of CO produced could be considerable. If the average concentration

of CO in the surface waters of the world ocean is approximately 10^{-5} ml/liter, and if it is assumed that the upper 2 m of water could release the major portion of its CO to the atmosphere in 24 hours (the values of R_{CO} even during the night would still result in a net transport of gas into the atmosphere), then in 1 year the ocean could contribute approximately 9×10^{12} g of CO to the atmosphere, based on a surface area of 3.61×10^8 km² for the world ocean. This amount represents about 5 percent of the estimated carbon monoxide produced by man, which makes the ocean by far the largest natural source of carbon monoxide known. If one assumes a worldwide production of carbon monoxide in the upper layers of the ocean similar to that found in the western Atlantic.

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The materials which follow were submitted for the record by Senator Boggs:

STATEMENT BY NATIONAL MARINE FISHERIES SERVICE BIOLOGICAL LABORATORY, OXFORD, MD.

This statement is directed to the problem of contamination of marine life by ocean dumping of polluted matter. We feel that we are qualified to speak on this subject since for the past 8 years our research biologists have been studying the most abundant commercial marine mollusk on the Atlantic coast, the surf clam, *Spisula solidissima*. The fishery for this large bivalve produced 66.8 million pounds of edible meats in 1970, over four times as much as produced by the hard clam fishery, the nearest competitor. These clam meats are used in almost all of the canned and processed clam products consumed by the public. It has been demonstrated that changes in the environment will change the faunal composition of the area. Therefore, maintenance of a valuable fishery producing large quantities of essential protein from the aquatic environment is equally important in our view, as the public health concern with potential contaminants of the marine resource.

On May 19, 1970, the Food and Drug Administration issued a warning, essentially closing to the shellfishery an area of about 120 square miles around the sewage dump site at New York and around the sewage dump site just off of Delaware Bay, because these areas were found to be polluted and the shellfish contaminated. These closures represent a considerable loss to the surf clam fishery.

We have established from intensive ocean sampling the coastal distribution of the surf clam over most of the area from the tip of Long Island to Cape Hatteras (Fig. 1). Surf clams are most abundant from nearshore to depths of about 120 feet, although they can be found in depths of 200 feet or more and nearly 50 miles offshore. Highest clam densities are particularly significant along the entire New Jersey coast, where the center of the fishery is presently located.

We have routinely interviewed vessels working off the New Jersey coast to determine fishing intensity (Fig. 2). Data from the interviews at the Cape May-Wildwood port show that 7.6 percent of the vessels had fished at the Delaware dump site in 1968 and 4.4 percent in 1969. The percentage of the fleet found actually fishing at the dump site was used to estimate an annual catch and value

of the site to the fishermen. In 1968, the estimates were 1.4 million pounds of meats worth \$158 thousand; and the same data for 1969 were 1.0 million pounds worth \$112 thousand. For both years, 2.4 million pounds of meats worth \$270 thousand were taken, or nearly 3 percent of the total U.S. landings. The 1970 closure, therefore, represents a dramatic loss to the Cape May fishery.

Settlement of larval surf clams is fortuitous, depending on many factors such as seasonal temperature, current direction, and intensity, light, sediment type, and length of survival. The clams fished for today settled 5 or more years ago and the abundance of any one year class is influenced by many environmental and biological factors. Therefore, abundance and distribution of clams is a constantly shifting mosaic pattern. For this reason, we chose five areas (Fig. 3), evenly spaced along the coast, to measure the potential loss to the resource from contaminant closures. The five areas are about the same depth and equal in size to the closed area, and the estimates are based on a comprehensive survey of the surf clam resources in 1965. The five areas contained an average 207.7 million clams living in the bottom, and the most productive area (No. 1 of Fig. 3) contained 284.6 million clams. Thus, if an average area could be completely fished, it would provide about 64 million pounds of meats, or nearly the equivalent of the entire 1970 catch of 66.8 million pounds which was worth \$7.7 million.

The Delaware closed area is considered to be somewhat marginal, at the present time, as a productive fishery area. But that occasional combination of ideal circumstances can occur at any location at any time, to provide a dense concentration of surf clams. Such a potential can never be realized if the environment is degraded and the clams polluted by ocean dumping.

We will not comment on the New York dump site, because the National Marine Fisheries Service laboratory at Sandy Hook, N. J., has recently completed a 2-year study of this area for the Corps of Engineers and their detailed report will be available shortly. However, we would like it to be known that quantities of juvenile surf clams have been found near the New York dump site and it might be assumed that surf clams would be abundant in the area, if they were not limited by the long-range physical and chemical damage of ocean dumping.

The impact of contaminants in the marine environment goes beyond the most visible problem of bacterial concentration and diseases transmission. It is known that heavy metals (e.g., mercury, lead, cadmium, chromium, etc.), pesticides, petroleum byproducts, radionuclides, and other chemical materials can be concentrated in areas used for ocean dumping. We tend to picture the concentration of contaminants directly over the dump site center, but consideration of ocean currents indicates that the materials may be widely dispersed, or even concentrated in pockets remote from the original site of disposal. Biological concentration may be equally critical in assessing the final impact of contaminants from ocean dumping. For example, plankton taking in low levels of contaminants near the dump site may be consumed by a predator and contaminants concentrated tens or hundreds of miles away. Although we know that many of these materials can be harmful to man, we have only meager information about the effects on the aquatic environment and living marine resources. Levels of contaminants that cause physiological changes in marine organisms, pathways of physical and biological concentration within the web of life, and tolerance to lengthy exposure to sublethal concentrations, are a few of the factors that need immediate evaluation.

The Oxford laboratory, in cooperation with other facilities of the National Marine Fisheries Service, is undertaking a detailed coastal study of selected dump sites in comparison with control, or uncontaminated, areas. By choosing similar target animals available at all sites, sampling on a regular periodic schedule, and subjecting the samples to a broad array of analytical procedures, both chemical and biological, we expect to begin to find answers to some of the problems that now face us.

Ocean dumping is undesirable—the ocean is no more a source of limitless dilution than the streams, rivers, lakes, and estuaries have been. Dumping further offshore only delays that point in time when a lasting solution must be found. Recent evidence indicates that materials deposited in deeper water are preserved for future generations, rather than undergoing normal decomposition and return of elements to the ecosystem. Even if ocean dumping is stopped immediately, we do not know the rate of natural recovery processes in dump sites, nor do we know the best methods to reclaim these areas by direct action.

We recommend that ocean dumping be terminated at the earliest possible moment. Until this can be accomplished, we recommend strict enforcement of the existing regulations for ocean dumping. If the ultimate problem is to be resolved, a concentrated technological effort must be made to find methods of recycling waste materials, and techniques must be developed to reclaim those areas of the Continental Shelf already despoiled by ocean dumping.

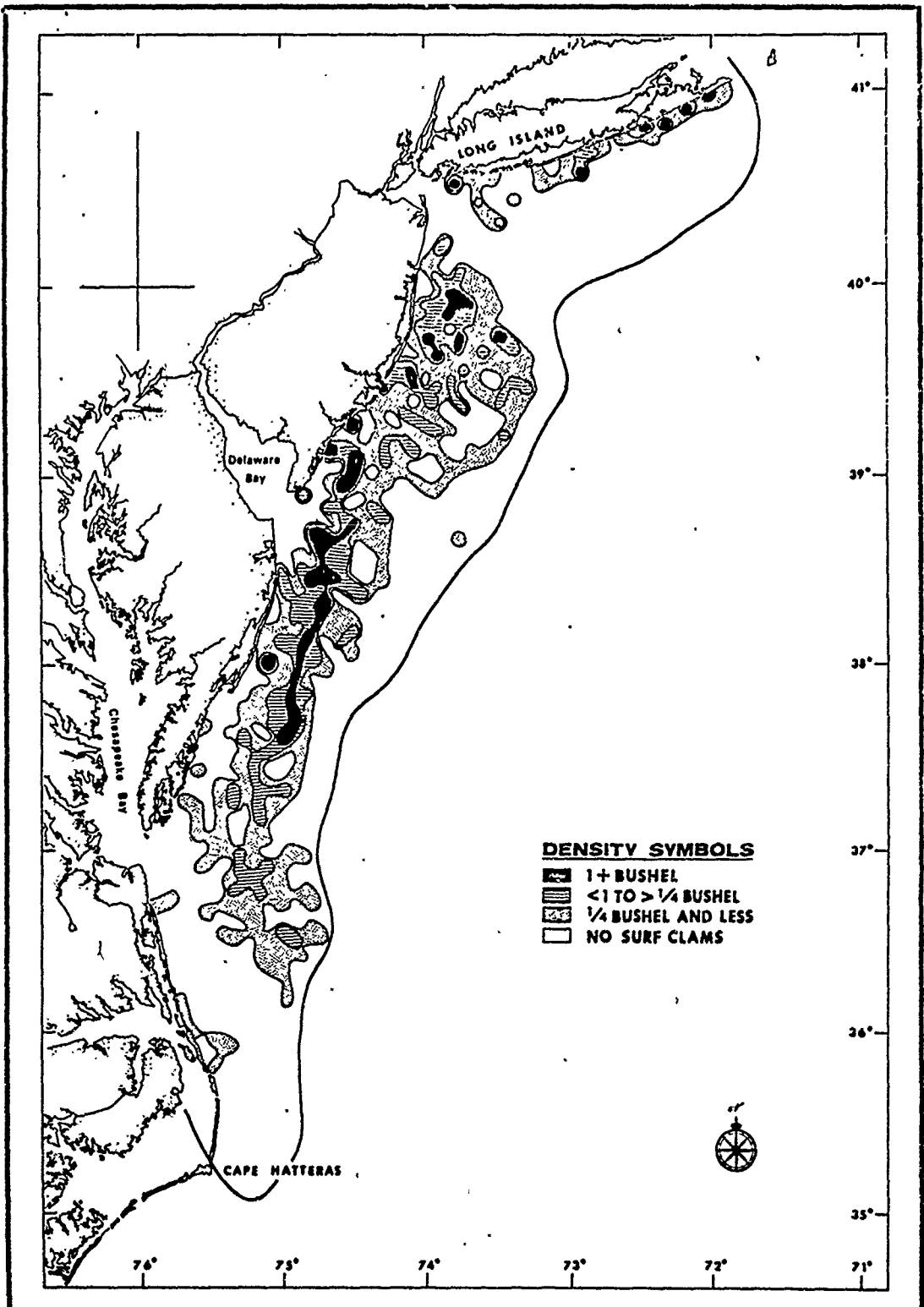


FIGURE 1.—The distribution and density of surf clams along the middle Atlantic coast from the results of a 1965 survey by NMFS.

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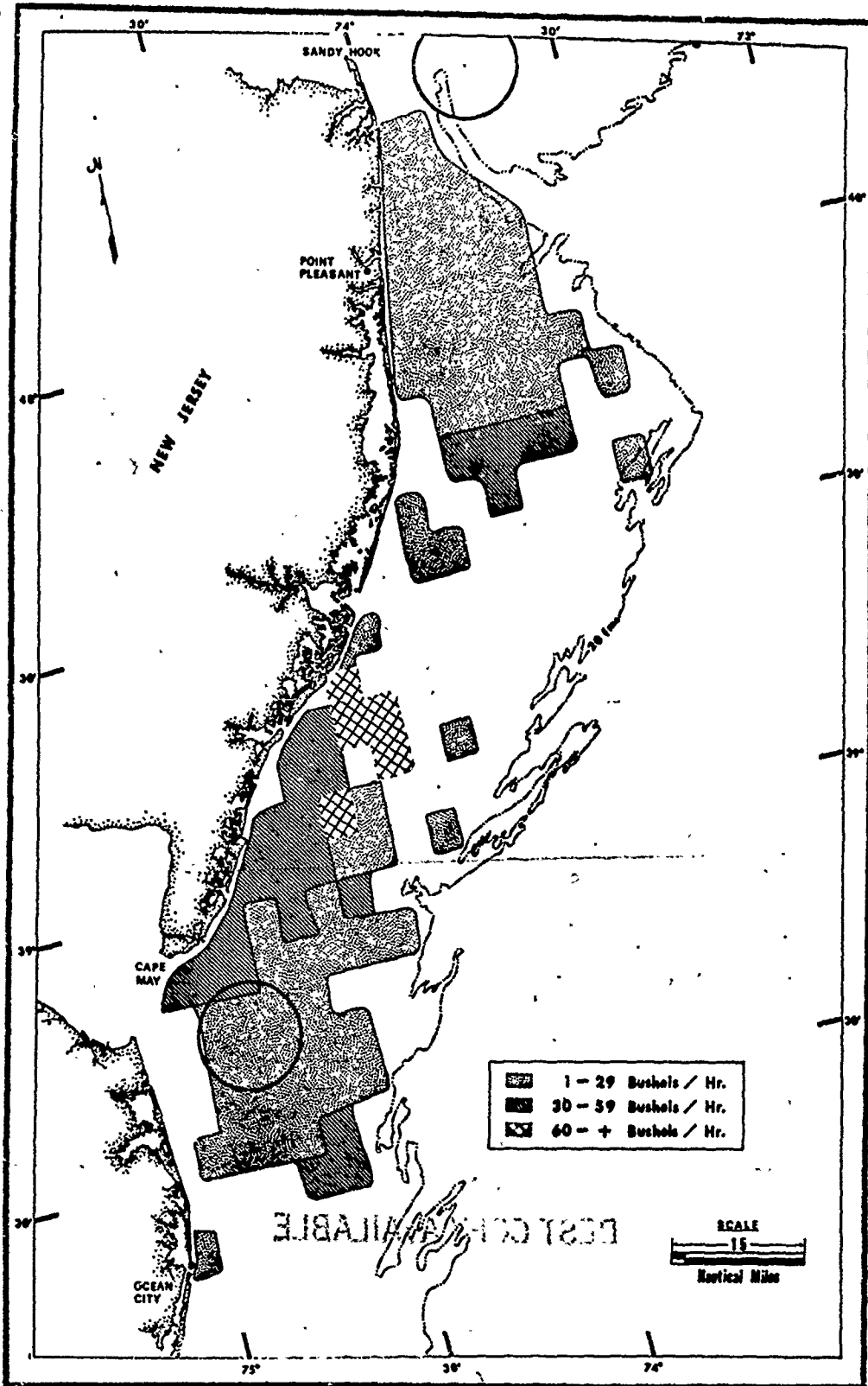
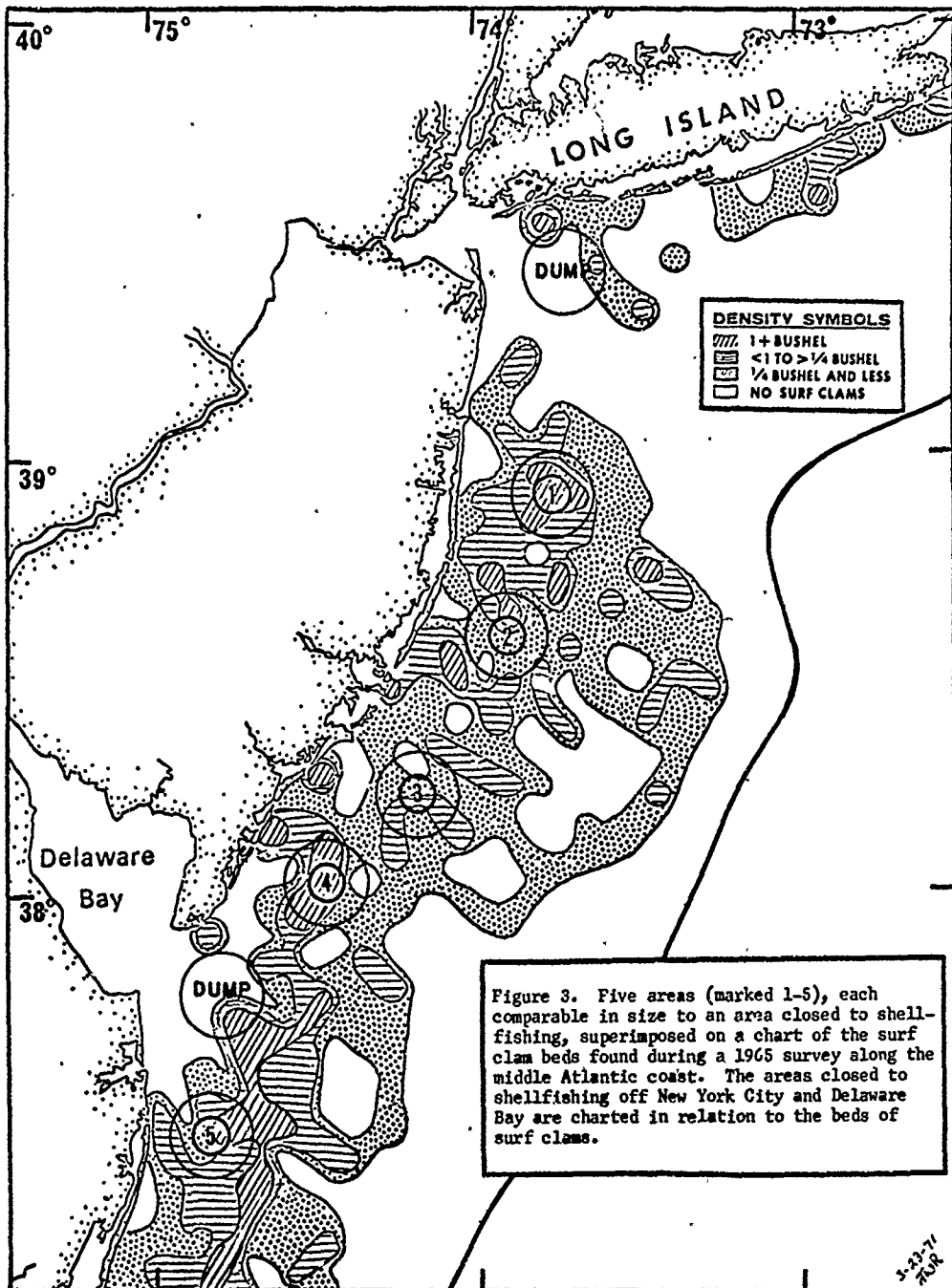


FIGURE 2.—Catch per hour within the area fished by the New Jersey surf clam fleet in 1969 (based on 1,955 interviews). The circles are areas closed to shell-fishing off New York City and Delaware Bay.

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[From the Delaware Coast Press, Rehoboth Beach, Del., Mar. 25, 1971]

SUBCOMMITTEE MEETS FRIDAY—TESTIMONY SCHEDULED FOR CONVENTION HALL

(By David S. Hugg)

The attention of many Americans and particularly those concerned about the menace to coastal areas posed by ocean dumping will be focused on Rehoboth Beach Friday.

Center of all this attention will be this resort community's Convention Hall where the U.S. Senate's Subcommittee on Air and Water Pollution will hold a day-long public hearing, its first on ocean dumping.

Chairing the hearing is Sen. Edmund S. Muskie of Maine, presently the acknowledged forerunner among those who aspire to the 1972 Democratic presidential nomination. He was his party's vice presidential candidate in 1968.

Sitting with Muskie will be such well known Congressional figures as Sen. Jennings Randolph (D-W. Va.) and Sen. James L. Buckley (R-N.Y.). Also Sen. J. Glenn Beall, Jr. (R-Md.) and Sen. J. Caleb Boggs (R-Del.)

The subcommittee also includes in its membership Senators Howard H. Baker, Jr. (R-Tenn.), Birch Bayh (D-Ind.), Lloyd M. Bentsen (D-Tex.), John Sherman Cooper (R-Ky.), Robert J. Dole (R-Kans.), Thomas F. Eagleton (D-Mo.), Joseph M. Montoya (D-N.M.) and James V. Tunney (D-Calif.)

It was not known at press time as to how many of this latter group would participate in Friday's hearing although Harold Brayman, a member of Senator Boggs' staff, had advised on Monday that some of these were still trying to re-arrange their schedules to permit attendance.

Boggs, Delaware's senior senator and senior minority party member of the subcommittee, had a prominent role in arranging for the holding of the hearing here.

The invitation to the subcommittee to hold a hearing at Rehoboth Beach was extended through Senator Boggs. It was tendered by the Mayor and Commissioners of Rehoboth Beach at the request of representatives of member organizations of the Stop Ocean Dumping Association who since mid-January have been meeting at two-week intervals at Rehoboth Beach.

S.O.D.A. was formed late last year by a group of southern New Jersey businessmen who had become alarmed at the menace to area beaches posed by the presence off their shores of 12-mile-in-diameter area used as a dumping site for sludge—partially treated sewage—transported by barges from the upriver cities. The Rehoboth Beach Chamber of Commerce last Dec. 8 had acquainted members of the local business community with the location and nature of the offshore dumping site which they described as a "dead sea".

They said that the western edge of the dumping site was only about 7½ miles off the Delaware Coast. They warned that a severe "northeaster" storm of several days duration could possibly result in the sludge being deposited on Delaware's beaches creating a health menace.

Understandably alarmed by the warning, members of the Rehoboth Beach trade organization sought and received additional information concerning the offshore dumping site. Their finding confirmed the S.O.D.A. representatives' claims that the dumpings site posed a menace to the health and well being of those who resided in and those who vacationed in the coastal communities of southern New Jersey, Delaware and Maryland, and to the beach-oriented economy of each.

Members of Delaware's Congressional delegation, Governor Russell W. Peterson, area members of Delaware's General Assembly, and various federal and state environmental agencies were then acquainted with the situation and urged to take remedial action.

These efforts paralleled similar activity on the part of the New Jersey-based S.O.D.A., an organization which the cities of Rehoboth Beach and Lewes and their respective Chambers of Commerce subsequently joined.

Meanwhile, representatives of various federal and state environmental agencies visited the dumping site. Their findings confirmed S.O.D.A.'s contention that marine life in the dumping area is now practically non-existent although empty clam shells and fish skeletons found in odorous, lifeless bottom samplings gives proof that abundant marine life once existed there.

In recent weeks, several bills for controlling ocean dumping have been introduced in both houses of Congress. It is believed that action on some of these will follow the holding of the hearing here.

According to information received from Senator Boggs' office, a rather distinguished group—including other members of Congress, the heads of various federal and state environmental agencies, and representatives of industry and of conservation organizations—will join representatives of coastal area communi-

ties in giving testimony before the subcommittee (a list of witnesses appears in a separate article appearing in this issue).

Indications are that the proceedings will be covered by press services and many metropolitan newspapers, radio and television stations.

The hearing will get underway at 9 a.m. and will continue until about 12:30 when there will be a luncheon recess. The hearing will be resumed at 2 p.m. and continue through the afternoon. Both sessions will be open to the public.

WITNESS LIST ANNOUNCED

In addition to bringing to Rehoboth Beach members of the U.S. Senate's Subcommittee on Air and Water Pollution, Friday's hearing on ocean dumping is also attracting a number of distinguished witnesses.

Included are other members of the Congress, the heads of various federal and state environmental agencies, scientists, and representatives of industry and of conservation groups.

While the governors of Delaware, Maryland and New Jersey have all been invited, it is likely that each will designate his top environmentalist to speak (Austin Heller, secretary of the Department of Natural Resources and Environmental Control, will represent Governor Peterson at the hearing).

High on the list of expected witnesses is Russell Train, chairman of the President's Council on Environmental Quality, who will express the views of the Nixon Administration.

Members of Congress, who are not a part of the Senate Subcommittee, but who have indicated plans for participation in the hearing, include Sen. Clifford Case (R-N.J.), Sen. Charles McC. Mathias (R-Md.), Sen. William V. Roth, Jr. (R-Del.), Rep. Charles Sandman (R-N.J.) and Rep. Pierre S. du Pont IV (R-Del.).

Among the experts in the environmental fields who are slated to give testimony are Capt. James L. Verber from the U.S. Public Health Service's Northeast Technical Service Center at Dansville, R.I.; Dr. Robert A. Erb, scientist with the colloids and polymers section of the Franklin Institute Research Laboratory, Philadelphia; and William S. Gaither, dean of the University of Delaware's College of Marine Studies.

Others slated to appear before the subcommittee include Col. Carroll Strider, district engineer with the Army Corps of Engineers at Philadelphia; Samuel Baxter, water commissioner for the City of Philadelphia; and a representative of the U.S. Coast Guard from Washington, D.C.

Others include Wilbur S. Ostrander of Wildwood, president of the Stop Ocean Dumping Association; Capt. Otto Stocker of Wildwood Crest, representing the southern New Jersey-based Party Boat Sports Fisherman Association; Clarence Shoffler of Wildwood, who still will be speaking for the commercial shell fishing industry of New Jersey, Maryland and Delaware; Donald Long, also of Wildwood, representing commercial clam processors; and Anthony Bianchi of North Wildwood who will represent hotel and motel operators of southern New Jersey, Maryland and Delaware.

Some of those named will be spokesmen for panels consisting of representatives of the three states.

For example, Austin Heller, the personal representative of Governor Peterson, will be flanked by several members of Delaware's General Assembly, including State Senator Thomas E. Hickman, Jr. (R-Bayard) and State Rep. Harry E. Derrickson (R-Rehoboth Beach).

Other Delaware resort area people who are slated to make oral presentations at Friday's hearing include Rehoboth Beach mayor Lester F. Johnson and the president of the community's Chamber of Commerce, David S. Hugg.

Johnson will be the spokesman for a panel of about a dozen mayors of resort communities in a three-state area. Hugg will be the spokesman for a panel expected to include Robert Gibbs of Lewes, Ronald Engle of Ocean City (Md.), Harry Lozur of the Greater Cape May Chamber of Commerce, and the presidents of other Chambers of Commerce and tourism promotional organizations in the three-state area.

In addition to those scheduled to make oral presentations before the subcommittee, there will be a large number of written statements submitted in behalf of various organizations and by individuals who have expressed concern about the menace to area beaches posed by the dumping of sludge in an area cited as being only $7\frac{1}{2}$ miles from the Delaware coast and $5\frac{3}{4}$ miles off Cape May, N.J.

MUSKIE, BOGGS, BEALL, BUCKLEY ARE AMONG SENATORS ATTENDING

Among the senators participating in the subcommittee hearing Friday will be four men well known to area residents. Chairman of the subcommittee is Edmund S. Muskie, 56, elected to the senate from Maine in 1968.

He is considered by most observers as the front running candidate for the Democratic Party presidential nomination in 1972, although he has not yet officially announced that he would seek the nomination.

Muskie's father was a Polish immigrant. The Senator attended Rumford, Maine, public schools, then was graduated "cum laude" in 1936 from Bates College, Maine. He was graduated "cum laude" from the Cornell University Law School in 1939 and returned to Maine, where he opened his law office.

During World War II, he enlisted in the U.S. Navy and served as an engineering and deck officer on a destroyer escort. He saw duty in both the Atlantic and Pacific theaters during 1942 to 1945.

Returning to Maine following the war, Muskie re-established his law practice. Sen. Muskie decided to seek elective office in 1946 because he says, like most fledgling lawyers he had few clients and plenty of spare time. He was elected to the Maine House of Representatives in 1946, 1948 and 1950 and served as minority leader in his second and third terms. He was elected Democratic National Committeeman from Maine in 1952, a position he held until 1956.

During the Korean conflict, he was the state of Maine's director of the U.S. Office of Price Stabilization.

In 1954, Muskie defeated the incumbent governor and thus became the first Democrat elected to the office in 20 years. He was re-elected in 1956.

In 1958, he successfully campaigned for the United States Senate, becoming the first popularly elected Democratic Senator in Maine history. He was re-elected in 1964 and 1970 by margins in excess of 60 per cent. In 1968, Senator Muskie was the Democratic Party's nominee for Vice President of the United States.

In the U.S. Senate, Muskie is currently a member of the public works, foreign relations and government operations committees. He is chairman of the subcommittees on air and water pollution, arms control and intergovernmental relations. He also is a member of the Senate select committee on aging and serves as chairman of the subcommittee of health for the elderly.

As chairman of the Democratic legislative review committee of the Senate, Muskie sits as a member of the Democratic policy committee, the majority party's leadership committee. He is also an assistant majority whip. From 1967 to 1969, he served as chairman of the Democratic Senatorial campaign committee.

Senator Muskie is married. He and his wife have five children.

Senator J. Caleb Boggs has been one of Delaware's senators since 1961. Born near Cheswold 61 years ago, he graduated from the University of Delaware in 1931 and received his law degree from the Georgetown University in 1937. He practiced law in Dover from 1938 to 1940 and after that in Wilmington. He was called to active service in 1941 as a member of the Delaware National Guard and served in the European theater including Normandy and the Rhineland.

He returned to the law in 1946 as Deputy Judge of the New Castle Family Court. In 1947 he was elected to the U.S. House of Representatives and served three terms. He moved on to the governorship in 1955 serving two terms, until his election to the senate in 1961.

In the case of Sen. Caleb Boggs of Delaware his primary area of national influence and leadership has developed from committee work and it concerns our environment—how to keep it unspoiled and how to correct the atrocities which have been committed against it.

He became a member of the Senate Subcommittee on Air and Water Pollution in 1963. Even though he had been a Senator for less than three years, he was the subcommittee's ranking member of the minority. Sen. Edmund Muskie of Maine, as the ranking majority member, took the post of chairman.

The same year the subcommittee was formed it produced the Clean Air Act of 1963.

"Ecology" was hardly the rallying word then that it is now. The concept of recycling waste seemed very far off. Interest in the subject of pollution was growing, but it had not penetrated the public's consciousness.

Muskie and Boggs, the subcommittee's leaders, continued to develop legislation in the field. The subcommittee's hearing helped disclose the vast and growing problem of pollution. Chairman Muskie naturally got the lion's share

of the publicity, but as one bill after another was passed he never failed to credit the cooperative work of the top minority member, Sen. Boggs.

James L. Buckley, 47-year-old New York City Attorney, is the junior U.S. Senator from New York. Buckley won his U.S. Senate seat last Nov. 3 in a three-way race which included Republican incumbent Charles E. Goodell and Democrat Richard L. Ottinger. Buckley is a Conservative Party member.

Buckley has had a life-long interest in natural history and conservation.

Senator Buckley joined the Catawba Corporation (New York City) as a vice president and director in 1953.

Sen. J. Glenn Beall Jr. (R-Md.) was born in Cumberland, Md. in 1927. He was educated in the public schools of Frostburg, Md., and at Phillips Exeter Academy in New Hampshire. He served in the U.S. Navy during World War II and then entered Yale University, receiving an A.B. degree in 1950.

In 1962 Glenn Beall was elected to the Maryland House of Delegates and chosen minority floor leader, a position he held up to his election to Congress in 1968.

In the U.S. House of Representatives Senator Beall served on the House Banking and Currency Committee and later on the Armed Services Committee. He was also the freshman representative on the Republican Policy Committee.

Senator Beall was elected in 1970 to the U.S. Senate seat once held by this father the late Senator J. Glenn Beall, Sr.

OCEAN DUMPING BILL INTRODUCED BY BOGGS

A bill calling for a six-month moratorium on all ocean dumping was introduced into the Senate last Friday by U.S. Sen. J. Caleb Boggs.

Titled the Emergency Water Pollution Prevention Act of 1971, this measure goes further than any one of several other ocean dumping control bills introduced recently in the Senate.

According to its terms, the ban would go into effect immediately upon enactment of the bill with penalties of not more than \$15,000 for each violation of the moratorium.

While the ban on dumping was in effect, the Environmental Protection Agency would be required to develop regulations for the future control of ocean dumping.

In introducing S.B. 1286, Senator Boggs said "The need for a prompt moratorium on dumping was clarified recently by a news report concerning the possible disposal into the Atlantic of a large quantity of deadly arsenic.

"Fortunately, the company intending to dump the arsenic agreed, when faced with an injunction, to delay dumping until Congress establishes a national policy on ocean disposal of waste. But we continue to face the daily danger of another company using the sea as a sewer for poisons."

Earlier in the week, Boggs also introduced a bill, co-sponsored by 30 other senators, that would require any industry or municipality to get a federal permit before they could dump material into the ocean.

This earlier measure would also designate federally approved and policed dumping sites, and would impose fines up to \$50,000 for any violation of its provisions.

A representative of Senator Boggs' office on Monday told the Delaware Coast Press that both of the Boggs-sponsored measures and other ocean dumping control measures introduced recently in the two houses of Congress will undoubtedly be discussed during the hearing schedules for Rehoboth Beach's Convention Hall this Friday.

[From the Evening Journal, Wilmington, Del., Jan. 18, 1971]

SEA DUMPS DUE PROBE

WASHINGTON.—Philadelphia sewage sludge disposal in the ocean off Delaware will be investigated by a Senate subcommittee after Congress convenes Jan. 21. Sen. J. Caleb Boggs, R-Del., said yesterday.

Boggs said the air and water pollution subcommittee will examine broad aspects of sewage treatment problems throughout the country with close attention to the Philadelphia practice and the even more extensive disposal of New York waste off Sandy Hook, N.J. Conservationists claim the New York dumping area has created many miles of ocean uninhabitable by marine life.

He said the committee might even schedule hearings in Rehoboth Beach or some other coastal site for an on-the-spot study of the effects of the disposal system.

Philadelphia's use of the ocean beyond Delaware's territorial limit as a dumping ground for the sludge was disclosed last month and provoked a string of protests from officials who feared contamination of part of the continental shelf and possible ruin of the beaches.

Boggs, No. 1 Republican on the subcommittee, said the first legislative priority in the pollution control field this year will be an extension of the federal program assisting states and local governments to build sewage-treatment plants and similar facilities. The program expires June 30.

[From the Evening Star, Washington, D.C., Feb. 27, 1971]

SLUDGE AND A SICK SHELLFISH—AIDES GET TRIP ON CLAMMER, STRONG POLLUTION ARGUMENT

(By Roberta Hornig)

WILDWOOD, N.J.—Federal antipollution officials have been given a graphic and smelly demonstration of what the dumping of sewage sludge near the mouth of Delaware Bay has done to a prime shellfish area in the last few years.

The two officials—David Dominick, head of the Federal Water Pollution Control Agency, and Gordon MacDonald, of the President's Council of Environmental Quality—traveled to this New Jersey resort area yesterday in response to efforts of a small but vocal environment group whose efforts were reported in The Star on Sunday.

Aboard the dredge-clammer "Miss Doxsee," the two federal executives and local officials and watermen churned through choppy seas to just inside an area that in May was designated by the Food and Drug Administration as contaminated for shellfish fishing.

About 14 miles out in the Atlantic, from the mouth of Delaware Bay, the clammer put down its dredge to prove that sewage sludge being dumped by Philadelphia and two New Jersey cities was destroying the watermen's livelihood.

CATCH PROVES "WRETCHED"

A spray from the bobbing sea splattered over the passengers, the dredge was dropped and hauled, twice producing nothing but "good clay bottom," as MacDonald described it.

On the third try, however, the New Jersey activists—banded together in a group called the "Stop Ocean Dumping Association," or SODA—made their point.

The dredge came up with 200 pounds of black, smelling sewage sludge—and a lot of dead clams. "Wretched" was the way MacDonald described the catch. He and Dominick, in a business suit, pawed through the black mess. What they found were many dead clams and one clam still alive, but "barely alive," MacDonald said after looking at it.

Capt. Otto Stocker, who for years has operated a sightseeing boat in the Cape May area and is a prime mover in the SODA group, looked at the sodden catch and said, if things "were right," the dredge in that area would have produced 60 to 70 bushels of good clams on a sweep. Stocker, in his 60s and who winters in Florida, had come up specially for the federal visit.

HEARING SCHEDULED

SODA got its start in May after the FDA declared the 120-square-mile dumping area off-limits for the shell fishermen.

Clarence Shoffer, who for years had watched his shellfish catch diminish as the dumping gained in volume, became a sort of catalyst in the formation of SODA.

SODA, its membership composed of energetic waitresses, watermen, realty agents, and the mayor of Wildwood, has generated tides of interest.

Hearings have been set for next month in Rehoboth Beach, Del., on the problem by Sen. J. Caleb Boggs, R-Del., the ranking member of Sen. Edmund Muskie's Air and Water Pollution Control subcommittee.

Dominick and MacDonald, during their visit to Cape May County, repeatedly urged the angry residents to seek a solution to their pollution problem by supporting President Nixon's Ocean Dumping Bill—introduced in the House, but not yet in the Senate because of a haggling over who will introduce the measure.

The legislation would, for the first time, extend American jurisdiction to 12 miles—compared to the current 3-mile limit—for ocean dumping. It also would require a permit from the U.S. Environmental Protection Agency for disposal within the 12-mile area. The Atlantic, about 100 miles from the mouth of the Delaware Bay, now is used as a dumping ground for industrial wastes, toxic chemicals, radioactive wastes, and military explosives.

Dominick told the SODA members that "this situation" in their area would provide "incentive to stop ocean dumping." He said the "tools" must be at hand—such as the President's proposal.

Cape May residents want the 140 million gallons of sludge dumped annually by Philadelphia, and Newark and Bridgeton, N.J., stopped immediately.

MacDonald told the SODA group that he sympathizes with their situation. He said that perhaps the federal government should respond temporarily to their pleas and seek, perhaps with federal assistance, to have the offending cities tow their sludge at least 100 miles offshore. Dominick, however, wondered if it was worthwhile to simply transfer the same problem to a greater distance.

As the 871-foot "Miss Doxsee" berthed after the trip into what the SODA group calls the "Dead Sea" area, the two federal officials continued to plead for support for Nixon's dumping bill. But the residents remained skeptical.

They have become activists and now are thinking in activist terms.

Said Stocker, "If a man's going to try to stop you from taking a living out here," referring to the cities' sludge dumping, "we'll shoot to kill if we have to do it to protect our interests."

The SODA people also are talking about an armada of clam boats to surround the sludge barges from Philadelphia, Newark and Bridgeton, as they pull their loads of waste out into the Atlantic.

[From the Delaware Coast Press, Mar. 4, 1971]

DERRICKSON ANGRY OVER "MESS" FOUND ON DUMPING SITE TOUR

(By David S. Hugg)

Harry E. Derrickson is angry.

He's been that way ever since last Friday when he, along with two high ranking federal environmental experts, accompanied Stop Ocean Dumping Association officials and representatives of southern New Jersey's fishing and clamming industries on a boat trip to an ocean dumping site about seven miles east of Rehoboth Beach.

His ire results from what he saw at the site.

He says that he will not rest until he has done everything possible—including the possibility of a court suit—to stop the practice of Philadelphia and other upriver cities barging sludge (partially treated sewage) to the site.

While he is pleased that the U.S. Senate Public Works Committee's Subcommittee on Air and Water Pollution is planning to hold a public hearing on the offshore dumping situation at Rehoboth Beach's Convention Hall on March 26, Derrickson, who represents this area in the state House of Representatives, plans to resume his efforts this week to get General Assembly approval of HCR-3, a House measure that would memorialize Delaware's Congressional delegation to support federal legislation aimed at stopping all dumping of sludge and chemical waste any closer than 100 miles of the New Jersey and Delmarva coasts.

He introduced the resolution in January just before the General Assembly recessed for a month-long period. His colleague, State Senator Thomas E. Hickman Jr., will, Derrickson says, introduce the resolution in the Senate after its anticipated passage in the House.

Derrickson also plans to talk with District Attorney W. Laird Stabler Jr., relative to the State of Delaware petitioning the U.S. District Court at Philadelphia for issuance of an injunction against any further dumping by the cities of Philadelphia, Camden and Bridgeton in the 12-mile wide site off the Delaware Coast.

In connection with such legal action, Derrickson points out that a precedent for such action was established in January when Congressman Charles W. Sandman Jr. (R.-N.J.) obtained an injunction from the District Court at Philadelphia that served to stop the proposed dumping of toxic chemical waste from a dormant Bucks County, Pa., plant at an ocean site about 30 miles off Ocean City, Md.

Sandman presently has a bill awaiting floor action in the U.S. House of Representatives that would forbid all dumping of sludge and chemical waste any closer than 100 miles off the Atlantic Coast. Derrickson's resolution would serve to encourage Delaware's Congressional delegation to support the Sandman bill or similar measures.

"It was a foul smelling mess. The only living that was brought up was a clam and it was obviously sick."

In these words, Derrickson describes the sample of bottom brought up Friday at the offshore dumping site.

His anger comes from the fact that "such a condition was ever allowed to develop off our coast." His ire has been intensified by what he terms "procrastination" on the part of the U.S. Army Corps of Engineers and other federal agencies in curtailing the present practice of dumping in coastal waters.

Since his return from Friday's five-hour boat trip to and around the offshore dumping site, Derrickson has taken a jugful of the smelly sludge, including the "sick clam" and a dead conch, to the University of Delaware Marine Laboratories at Lewes for analyzing.

He plans to later take the same material to Dover for further testing by technicians with the state's Department of Natural Resources and Environmental Control.

[From the Delaware Coast Press, Mar. 4, 1971]

SENATE SUBCOMMITTEE HEARING ON POLLUTION SET FOR REHOBOTH

The U.S. Senate's Subcommittee on Air and Water Pollution will hold a public hearing on ocean dumping off the Delmarva and New Jersey coasts on Friday, March 26.

The hearing, scheduled to get underway at 9:30 a.m. and continue through the day, will be held at Rehoboth Beach's Convention Hall, a facility being made available by the city.

The hearing resulted from acceptance by the subcommittee of an invitation extended by the City of Rehoboth Beach through Sen. J. Caleb Boggs, Delaware's senior senator and ranking Republican member of the subcommittee.

Boggs made announcement of the subcommittee's acceptance of the invitation last Thursday.

In making the announcement, Boggs said that "the subcommittee has decided to visit Rehoboth Beach because there are a great number of persons working and living near there who daily confront the problems of ocean dumping. Their testimony will be of great value to the subcommittee in studying the environmental damage caused by ocean dumping and various alternative methods of disposing of pollutants.

"They will help us write legislation to enhance the coastal environment: to protect the beaches and preserve the shellfish beds so important to the economy of the Delmarva area," Boggs said.

The subcommittee, which is a part of the Senate Public Works Committee, handles most pollution control bills for the Senate.

While here, its members will hear testimony from witnesses who represent governmental, civic and industrial groups in Delaware, New Jersey and Maryland. Representatives of many of these groups have been meeting here at two-week intervals under the auspices of the Rehoboth Beach Chamber of Commerce and the New Jersey-based Stop Ocean Dumping Association.

Following a Feb. 12 meeting of representatives of Delmarva coastal communities and their Chambers of Commerce and S.O.D.A. officials, the city government voted to extend an invitation to the subcommittee to hold a hearing here.

In addition to Boggs, the members of the subcommittee are: Edmund S. Muskie (D.-Me.), chairman; John Sherman Cooper (R.-Ky.); Jennings Randolph (D.-W. Va.); Howard H. Baker, Jr. (R.-Tenn.); Birch Bayh (D.-Ind.); Robert J. Dole (R.-Kans.); Joseph M. Montoya (D.-N.M.); J. Glenn Beall, Jr. (R.-Md.); Thomas F. Eagleton (D.-Mo.); James L. Buckley (R.-N.Y.); John V. Tunney (D.-Calif.); and Lloyd M. Bentsen (D.-Tex.).

[From the Delmarva News, Delaware, Mar. 4, 1971]

AT REHOBOTH BEACH—HEARING SET ON OCEAN POLLUTION

The Senate Subcommittee on Air and Water Pollution has announced that it will hold a hearing concerning pollution of the ocean on Friday, March 26, in Rehoboth Beach.

The hearing will consider the problems created when sewage sludge and other wastes are dumped into the Atlantic Ocean near the shores of Delaware and neighboring states, according to Senator J. Caleb Boggs (R-Del.). Boggs, the ranking Republican member of the Subcommittee, which handles most pollution control bills for the Senate, has requested the hearing.

"Ocean dumping is the only major pollution problem that remains completely uncontrolled," Boggs said. "Millions of gallons of sewage sludge are dumped each month within a few miles of Rehoboth Beach, one of the nation's most popular beaches. No existing laws prevent or regulate this dumping."

Boggs is a sponsor of several bills that would establish regulations on dumping beyond three miles from the coast. Some proposals call for a federally regulated permit system and assigned dumping sites far offshore.

The members of the Subcommittee will visit Rehoboth Beach to hear testimony from witnesses who represent governmental, civic, and industrial groups in Delaware, New Jersey, Maryland, and Pennsylvania.

"The subcommittee has decided to visit Rehoboth Beach because there are a great number of persons working and living near there who daily confront the problems of ocean dumping," Boggs said. "Their testimony will be of great value to the Subcommittee in studying the environmental damage caused by ocean dumping, and various alternative methods of disposing of pollutants."

"They will help us write legislation to enhance the coastal environment: to protect the beaches and preserve the shellfish beds so important to the economy of the Delmarva area," Boggs said.

The city of Philadelphia dumps its sewage sludge at a location twelve miles from Rehoboth Beach. Industry uses several dumping sites for its wastes farther offshore.

In addition to Boggs, the members of the Subcommittee are: Edmund S. Muskie (D-Me.), Chairman; John Sherman Cooper (R-Ky.); Jennings Randolph (D-W. Va.); Howard H. Baker Jr., (R-Tenn.); Birch Bayh (D-Ind.); Robert J. Dole (R-Kans.); Joseph M. Montoya (D-N. Mex.); J. Glenn Beall Jr. (R-Md.); Thomas F. Eagleton (D-Mo.); James L. Buckley (R-N.Y.); John V. Tunney (D-Calif.); and Lloyd M. Bentsen (D-Tex.).

[From the Delaware Coast Press, Mar. 4, 1971]

INSPECTION TRIP MADE—"VERY SICK CLAM" ONLY LIFE FOUND

A "very sick clam" was the only sign of life that federal environmental experts could find on a Friday visit to a sludge dumping site about seven miles off the Delaware coast.

The ailing clam was in samples of sludge dredged from the ocean bottom in a 120-square-mile area that has been used as a dumping site for partially treated sewage conveyed by barges from Philadelphia, Camden and Bridgeton.

Empty clam shells and other evidence of deceased marine life were found in the samples examined by Gordon J. F. MacDonald, a member of the President's Council on Environmental Quality, and David D. Dominick, commissioner of the Water Quality Administration of the Federal Environmental Protection Agency.

The samples were described by MacDonald and Dominick as a "decaying, toxic mess having the odor of rotten eggs".

"Whatever it is, it seems to have killed the total marine community in the area, even the small organisms", said Dominick.

Upon return to Wildwood, both MacDonald and Dominick advised that they would recommend an immediate, systematic study by the Environment Protection Agency of present and potential dangers of the area.

MacDonald noted that the Food and Drug Administration just last year had designated the dumping site as being contaminated and had disallowed further fishing or clamming in the area.

MacDonald and Dominick visited the site at invitation of the Stop Ocean Dumping Association, a Wildwood-based organization having as its basic goal the curtailment of all dumping in offshore waters.

They flew into Cape May County Airport on Thursday evening and met with S.O.D.A. officials for a briefing. The trip to the dumping site was made in Capt. Eric Kirkberg's commercial clamming boat.

Among those who accompanied MacDonald and Dominick in their tour of the offshore dumping site was Harry E. Derrickson, Rehoboth Beach businessman and legislative chairman of the resort community's Chamber of Commerce.

[From the Christian Science Monitor, Mar. 8, 1971]

WHY COWARDLY ABOUT CLAMS?

In Delaware Bay, which divides Delaware from New Jersey, the clam industry has run afoul of sewage sludge barged from cities upriver like Philadelphia. The Food and Drug Administration said last year that clams from the ocean off the bay couldn't be marketed. But, according to reports, the federal government says it is powerless to halt the dumping which is ruining the beds.

On the other side of the continent, the federal government found it in itself to halt the operations of the one U.S. whaling company—whose work took it way beyond the three-mile limit at which, officials say, their jurisdiction ends. If the government can in effect halt clamming, if it can halt the ocean operations of an industry wholly without regard to distance, why can it not end the ocean dumping of municipalities?

There are solutions to the municipal waste problem. Wastes could be hauled to strip-mined regions in nearby states and used to restore the land. And if wastes must go to the sea, President Nixon has proposed legislation that would make dumpers prove they aren't hurting the environment. But it is thought an actual end to coastal pollution is some years away.

Again, this doesn't make sense. Given the recent decisive actions of the government to end other off-shore threats, the implied impotence of the nation to end seafood-bed pollution cannot be accepted.

[From the Philadelphia Inquirer, Mar. 12, 1971]

ARSENIC CARGO TO BE SUNK OFF JERSEY; ACTION ADDS TO HAZARDS IN "OCEAN DUMP"

(By Mike Clark)

Seventy tons of an arsenic compound are scheduled to leave Philadelphia on Saturday for dumping in the Atlantic Ocean about 150 miles off the New Jersey coast.

The cargo is being handled by Norton Lilly Co., a steamship agency representing a number of lines in Philadelphia.

The firm, which booked the compound, said similar cargoes had been booked once a month over the past two years.

The cargo consists of an arsenic industrial waste, a byproduct from Whitmoyer Laboratories of Myerstown, Pa., a subsidiary of Rohm & Haas Co.

Dr. Gordon McDonald, the lone scientist on the three-man U.S. Council on Environmental Quality, which opposes ocean dumping of toxic materials, said such action is against the principles expressed by President Nixon.

Dr. McDonald said the worry in this particular case is that when the 246 canisters containing the arsenic compound hit the water, they break open and the sea water changes the composition of the chemical, making it particularly toxic to sea life in the area.

Whitmoyer Labs produces pharmaceutical, biological, nutritional and sanitation products for the animal agricultural industry. A company spokesman said it was impossible to dispose of the byproduct in any other way. The plant's other wastes are minor and are handled locally he said.

According to G. C. B. Bradford, local manager for Norton Lilly, there never before has been any problems related to the dumping.

"We get the authorization of the U.S. Army (Corps of) Engineers, the U.S. Coast Guard and Customs," he said. "They have been notified every time we have taken this cargo."

When asked about the 150-mile limit, Bradford said he believed the arsenic was taken out even farther.

"I think they take it out to the middle of the ocean before dumping it."

"We understand about this new anti-pollution—let's save the seas, of course," said a spokesman for Norton Lilly. But, he added, "the only thing here is we're in the middle. If we're wrong I'd appreciate it if we'd get some official notification."

A spokesman from the Coast Guard in Gloucester said the Guard is notified routinely if a dangerous cargo—such as arsenic—is being handled. But once it is aboard, the Coast Guard's jurisdiction ends.

At least twice a week—and sometimes three times—an ocean-going tug edges up to a city-owned pier at Wheatshelf lane and the Delaware River in Northeast Philadelphia.

After maneuvering into position, a line is secured to a barge. Shortly thereafter, the tug, with the barge in tow, heads downriver pulling Philadelphia's contribution to what is now being considered a major environmental problem: ocean dumping.

The tug, containing a portion of the 118 million gallons of digested sludge that the city dumps each year, is bound for a two-square-mile dispersal area, located 10 miles off Cape May. When it arrives, the barge opens, and the sludge is dumped into the water while the tug continues back to shore, completing the trip in 30 hours.

Each and every year, Philadelphia dumps at least 90 million gallons of sludge into the ocean. Camden contributes 10 million yearly while Bridgeton dumps six.

But the three cities barely make a ripple in the tide when compared to the total amount of material dumped into the ocean along the Atlantic Coast.

Figures show, for example, that an estimated 48 million tons of wastes were dumped along the coast in 1968; an estimated 50 to 55 million tons in 1969 and, when the total of dredge spoils, industrial wastes, sewage sludge, construction and wastes and miscellaneous materials is totaled up for 1970, the figure may be double that.

In January, the Pennsylvania Department of Environmental Resources contracted with a New Jersey firm to neutralize several million gallons of toxic chemicals being held in waste lagoons of an apparently abandoned chemical company in upper Bucks County.

The waste, considered a major health hazard for the area, was slated to be dumped off the coast of New Jersey, bringing howls of protest from politicians and the \$40 million Garden State shellfish industry. It also brought a court suit from Rep. Charles Sandman (R., 1st District) which stopped the move dead in its tracks.

When the smoke and rhetoric cleared, the treated wastes ended up far to sea but in their wake, SODA—Stop Ocean Dumping Association—was formed. Sandman introduced a bill in Congress which would eliminate ocean dumping within 100 miles of shore. Other similar bills are in the Federal legislative hopper along with recommendations for action from the Nixon Administration.

New Jersey has a special interest in seeing some sort of legislation passed—and soon. The dumping of sludge by Philadelphia, Camden and Bridgeton has knocked out shellfishing in the area, bringing a host of complaints from New Jersey's shellfish industry.

Tests have shown shellfish from contaminated areas to contain hepatitis, polio virus and other pathogens. Around the country, pollution has closed at least one-fifth of the nation's commercial shellfish beds, while beaches and bays have been closed to swimming and other recreation.

Off of New York City, for example, where dumping has been going on for some time, there is a 12-square-mile "dead sea" where no fish can live nor bottom organisms survive. The fish are killed by the toxic materials released from deposited sludge while that same material, smothers bottom-dwelling life in a host of toxic pollutants.

The U. S. Army Corps of Engineers, which regulates dumping in inland waters, has no control over dumping beyond the traditional (and legal) three-mile limit. As a result they have no control over the cities of Philadelphia, Camden and Bridgeton dumping sewage sludge off Cape May.

Since it is cheaper that way, much of the sludge that ends up off Cape May is untreated, raw sludge. But in Philadelphia's case, sludge goes through a complex 25-day treatment which eliminates much of the unstable effects of the discharge.

Carmin Guraino, deputy water commissioner in charge of pollution control, pointed out that out of 100 million gallons of sludge from the city, approximately 90 million of that is water. Five million gallons of the sludge is a sandlike material while the other five million can be considered actual sludge.

[From the Morning News, Wilmington, Del., Mar. 13, 1971]

ARSENIC DUMPING DELAYED

(By Wally Judd)

A Pennsylvania chemical company has postponed dumping 70 tons of arsenic compounds off Delaware shores under pressure from top Federal environmental officials and a Federal restraining order.

Whitmoyer Laboratories of Myerstown, Pa., a subsidiary of Rohm & Haas Co., had planned to dump the cargo today 150 miles out to sea. The chemical was on board the Nondo Fassio of the Norton Lilly Co., Philadelphia.

The company has been dumping about the same quantities of wastes once a month for the last two years, according to Dr. Gordon J. F. MacDonald, the ocean dumping expert on the President's Council on Environmental Quality.

MacDonald said the wastes were "potentially toxic."

Russell E. Train, chairman of the council, sent a telegram to the company saying that though the legal authority to stop the dumping may be questionable, the dumping was "clearly counter to the spirit of the policy of dumping toxic wastes enunciated by President Nixon."

William D. Ruckelshaus, Environmental Protection Agency administrator, also sent a telegram asking the company not to dump and to seek an alternative disposal method because of the "deleterious and probably lethal effect on the fish and other aquatic biota."

Rep. Charles W. Sandman, R-N.J., who has fought several other ocean dumping projects in the area, secured a three-day temporary restraining order in Philadelphia U.S. District Court yesterday. He will seek a permanent injunction Monday.

Sandman had been working on the restraining order all day, but Vincent Gregory, president of Rohm & Haas, announced before the restraining order that although he felt the dumping would not harm the environment, the company would discontinue the operation until the Federal Government is satisfied that the dumping would be safe.

A meeting with Sandman has been set for Monday and a meeting of the Council on Environmental Quality has been set for Friday. Sandman says he has been denied permission to attend the Friday meeting.

MacDonald said he was not sure of the effect of the arsenic dumping because some arsenic compounds are toxic and some are not. However, in this case, he said the potential danger of the arsenic mixing with seawater was unknown.

William Ambrogi, president of Whitmoyer, said the wastes are generated in the manufacture of arsenic acid, an animal fodder additive used to stimulate growth. He claimed the wastes were in tar-encased drums which would sink to the ocean bottom and would not diffuse into sea water even if the drum broke open.

Sandman said consumer advocate Ralph Nader has called him and shown an interest in getting into the case.

"We plan to tour their plant on Monday," Sandman said. "If they can prove their operation harmless, we'll apologize. If not, we'll make the restraining order permanent."

Delaware's top environmental official, Austin N. Heller, secretary of Natural Resources and Environmental Control, said he was looking into ways to prevent the dumping because the ship passed through Delaware waters. But he said he doubted if he had the legal authority.

Rep. Pierre S. du Pont IV, who Heller contacted, said he formally urged the U.S. Justice Department to go into Federal court for the injunction and to check into the legal aspects of transporting toxic wastes through navigable waterways.

Nixon has proposed legislation giving the Federal Government authority over ocean dumping by requiring permits before a ship leaves port. Now the government has jurisdiction only within a 3-mile limit.

Sandman circumvented the tricky jurisdictional question by telling the court yesterday that the company could have shot dumping the cargo inside the 3-mile limit; the material could float back inside the 3-mile limit, and the fish which might consume the toxic material might be caught within the 3-mile limit.

[From the Evening Journal, Wilmington, Del., Mar. 13, 1971]

ARSENIC DUMPING OFF; HEARING SET

Hours before a federal judge issued a temporary order yesterday restraining a Pennsylvania chemical company from dumping an arsenic compound into the ocean off Delaware, the firm announced it was suspending its dumping plans.

U.S. District Judge Donald W. Van Artsdalen, who issued the restraining order, scheduled a hearing Monday to determine if the ban should be made permanent.

The order had been sought by U.S. Rep. Charles W. Sandman, R-N.J., who has fought several other dumping projects in the past.

The court order bars the Norton Lilly Co. of Philadelphia, shipping contractors for Whitmoyer Laboratories of Myerstown, Pa., from dumping the compound in the Atlantic.

Whitmoyer, a subsidiary of Rohm & Haas, had scheduled shipment of 70 tons of arsenic wastes, but bowed to government concern about possible dangers to fish and humans.

Vincent Gregory, president of Rohm & Haas, said the operation would be discontinued until the federal government is satisfied it would be safe.

The chairman of the President's Council on Environmental Quality Russell E. Train, had sent a telegram to the company saying that although the legal authority to stop the dumping may be questionable, the dumping was "clearly counter to the spirit of the policy of dumping toxic wastes enunciated by President Nixon."

William D. Ruckelshaus, Environmental Protection Agency administrator, had also wired the firm, asking that it not dump, but seek an alternative disposal method because of the "deleterious and probably lethal effect on the fish and other aquatic biota."

U.S. Rep. Pierre S. du Pont IV, R-Del., said he had urged the Justice Department to go into federal court for the injunction and to check into the legal aspects of transporting toxic wastes through navigable waterways.

Du Pont had been contacted by Austin N. Heller, secretary of the State Department of Natural Resources and Environmental Control, who had said he would like to block passage of the ship through Delaware waters.

The Delaware coast will be spared other ocean dumping as well.

Within a month, the city of Bridgeton, N.J., expects to stop dumping sludge into the contaminated federal ocean dumping grounds off Delaware.

Bridgeton Mayor Bertram R. B. Aitken said the sewage sludge will be reclaimed, treated and recycled for use as fertilizer in area nurseries and farms. He said he expected to dispose of all of the city's sewage sludge in this fashion.

A New Jersey citizens group had been actively trying to stop the dumping of one and one-half million gallons of sewage sludge annually from Philadelphia and Camden and Bridgeton, New Jersey. Bridgeton dumps in about 10 percent of that total but the sludge is undigested or untreated, according to Dr. Gordon J. F. Mac Donald, the ocean dumping expert on the President's Council on Environmental Quality. The dumping site is a 120 square mile area which comes as close as seven miles to Cape Henlopen and Rehoboth Beach.

[From the Delaware State News, Dover, Del., Mar. 15, 1971]

SEA DUMPING EYED BY BEACH MAYORS

REHOBOTH BEACH—Mayor Lester F. Johnson of Rehoboth Beach has called a luncheon meeting today for 13 mayors from the Delaware and New Jersey resort areas to discuss the upcoming hearing on ocean dumping.

Johnson said today he wasn't sure how many of the mayors could attend, but said he was sure the mayors of the local resort areas (Leves, Bethany Beach, Fenwick Island and Ocean City) would be on hand.

The mayor said he hadn't had time to contact all the New Jersey mayors, but would do so after today's meeting, to fill them in on what had taken place.

Today's meeting, Johnson said, is to get the mayors together and explain how the hearing will be conducted.

"I'm going to ask each mayor to write a paper as long or short as he wants, expressing the opinion of his community. All of that will be handed in at the hearing," Johnson explained.

Johnson said on the hearing date (Friday, March 26) he will have as many mayors as possible to sit with him and answer the questions from the members of the subcommittee.

The hearings by the U.S. Senate Subcommittee on Air and Water Pollution will begin at 9:30 a.m. in the Rehoboth Convention Hall.

In business at Friday night's City Commission meeting, Rev. Charles I. Carpenter was named to the commission's nonresident seat, left vacant by the recent death of Fulton J. Downing.

Carpenter, a Milford resident, is a retired Air Force chaplain. He will serve until the city's annual election in August.

Frank L. Coveleski was named as supervisor of the Rehoboth Beach Patrol for the upcoming resort season. Coveleski has held that position for 16 years.

[From the Delaware State News, Dover, Del., Mar. 18, 1971]

WITNESSES NAMED FOR OCEAN DUMPING MEET

(By Rich Friedel)

REHOBOTH BEACH.—A tentative list of those scheduled to testify at the day-long hearing on ocean dumping to be held by the U.S. Senate Sub-Committee on Air and Water Pollution has been released.

The hearing is set to begin at 9:30 a.m. March 26 in the Rehoboth Beach Convention Hall.

According to Hal Brayman, legislative assistant for Sen. J. Caleb Boggs (R-Del.) who deals mainly with matters of the sub-committee, this will probably be the only hearing to be held on ocean dumping anywhere in the U.S.

"It will probably be the only opportunity the committee is going to have to focus its attention on this problem in a concerted effort," Brayman commented, "so we felt we had to get people who could speak from the national point of view to tell what's happening everywhere in the country . . . and then have local citizenry identify the problems they have."

High on the list of expected witnesses is Russell Train, chairman of the president's Council on Environmental Quality. He is the administration's top environmental expert.

Another expert is Capt. James L. Verber from Rhode Island, who works for the U.S. Public Health Service. "He has done a lot of research on the effects of sewage sludge on marine life, and I gather he's quite an expert," Brayman commented.

Senators expected to attend the hearings and make some comments on ocean dumping are William V. Roth Jr. (R-Del.), Harrison Williams (D-N.J.), and J. Glenn Beall (R-Md.).

Sens. Clifford Case (R-N.J.) and Charles McC Mathias (R-Md.) have conflicts and it isn't known at this time whether they can attend the hearing.

Members of the House slated to appear are Rep. Pierre S. du Pont IV (R-Del.) and Charles Sandman, a Republican who represents southern New Jersey.

Other federal witnesses will include a representative from the U.S. Army Corps of Engineers from Philadelphia and the U.S. Coast Guard out of Washington.

According to Brayman, the Coast Guard will give information on the surveillance of barges and explain how dumping can be controlled if a regulatory bill is enacted. Since there is no law controlling dumping, the Corps of Engineers is the only group that keeps track of ocean dumping that takes place outside the three mile territorial waters of the U.S.

Witnesses are also expected from within the various states. Invitations have gone out to Governors Russell W. Peterson of Delaware, William Cahill of New Jersey and Marvin Mandel, of Maryland. Each governor is expected to send his top environmentalist to speak. (Austin Heller, secretary of the Department of Natural Resources and Environmental Control, will speak for Gov. Peterson).

Most of the sludge being dumped off the Delaware coast is coming from Philadelphia, and the head of that city's sewer department will testify. Testimony will also be taken from the head of a Franklin Institute study which is underway to determine the effect of the dumping on marine life and water quality in the dumping area.

The study was undertaken recently at the request of Philadelphia officials.

Other witnesses will be Dr. William S. Gaither, dean of the College of Marine Science at the University of Delaware, and Wilbur J. Ostrander, president of the Stop Ocean Dumping Association (SODA).

SODA is a Wildwood, N.J.-based organization formed last year to protest ocean dumping.

As a time-saving measure, the subcommittee will hear testimony from several panels representing local interests in the three-state area. One panel will consist of 13 mayors of various resort areas, mostly in New Jersey and Delaware.

Rehoboth Mayor Lester F. Johnson, who will be the spokesman for the group, has asked each mayor to write a paper to be turned in to the committee.

Another panel will consist of the presidents of 13 Chambers of Commerce from New Jersey, two from Delaware (Lewes, Rehoboth Beach), and one from Maryland (Ocean City).

David Hugg, president of the Rehoboth Chamber of Commerce, will make a short oral presentation and submit papers to the committee.

Two other panels will represent the fishermen from the various states and the clam processing industry from New Jersey and Maryland.

"We figure those panels will more or less cover local interests, and then with the state and federal representatives we'll cover the national picture," Brayman explained.

According to committee procedures, each witness must have a printed copy of his presentation to be given to the committee.

At the end of the day, if there's any time left, the committee will hear testimony from persons not on the witness list.

According to Brayman, about 80 per cent of pollution from ocean dumping is on the East Coast in the areas off New York and Delaware. The problem does not exist on the West Coast, he said, because the continental shelf is much closer to shore and the waste can be dumped at much greater depths without having to barge it very far out to sea.

[From the Delmarva News; and the Delaware Coast Press, Rehoboth Beach, Del., Mar. 18, 1971]

DUMPING OF 70 TONS OF ARSENIC OFF DELMARVA COAST HALTED

BULLETIN

Sen. J. Caleb Boggs introduced legislation Tuesday calling for federal supervision of all waste dumping in oceans off the United States.

Boggs said the bill, part of the Administration's environmental protection program, "would establish a permit system to prevent or seriously limit the use of the oceans off the United States as sewers."

Some 70 tons of an arsenic compound scheduled for transport down the Delaware River and Bay to a dumping site 150 miles off the Delmarva coast was not moved on Saturday as initially announced.

Shortly before a federal judge on Friday issued a temporary order restraining a Pennsylvania chemical company from moving and dumping the potentially lethal cargo, the firm announced it was suspending its dumping plans.

The restraining order, issued by U.S. District Judge Donald W. Van Artsdalen, upon request of U.S. Rep. Charles W. Sandman Jr., (R-N.J.), would have had the effect of stopping the movement of the arsenic compound pending a hearing to determine if the ban should be made permanent.

The chemical waste, packed in 246 canisters, was to have been transported by the Norton Lilly Co. of Philadelphia, as shipping contractors for Whitmoyer Laboratories, a Myerstown (Pa.) subsidiary of Rohm & Haas.

Announcement of plans to move the arsenic compound drew protests from Russell E. Train, chairman of the President's Council on Environmental Control; William D. Rickelshaus, administrator of the federal Environmental Protection Agency; Rep. Sandman; U.S. Rep. Pierre S. du Pont (R-Del.); and Austin N. Heller, secretary of Delaware's Department of Natural Resources and Environmental Control.

Also protesting were officers and members of the Stop Ocean Dumping Association, a three-state organization of coastal cities, Chambers of Commerce, commercial fishing and clamming interests and conservation groups who are opposed to all offshore dumping.

Meanwhile, planning for a hearing on offshore dumping to be conducted at Rehoboth Beach's Convention Hall on March 26 by the U.S. Senate's Subcommittee on Air and Water Pollution, is progressing, according to word from the office of U.S. Sen. Edmund S. Muskie (D-Me.).

Muskie is chairman of the subcommittee of which Sen. J. Caleb Boggs (R-Del.) and Sen. J. Glenn Beall Jr. (R-Md.) are members.

According to David S. Hugg, president of the Rehoboth Beach Chamber of Commerce and Delaware director of the Stop Ocean Dumping Association, final planning for area participation in the March 26 hearing will be accomplished at a luncheon meeting this weekend of representatives of the Rehoboth Beach, Lewes and Ocean City (Md.) Chambers of Commerce and other hearing participants.

As a result of earlier meetings of this group, the City of Rehoboth Beach, following a Feb. 12 meeting of Mayor and Board of Commissioners, extended the invitation to the Senate subcommittee to hold a hearing at Rehoboth Beach.

WASHINGTON, D.C., March 9, 1971.

Hon. J. CALEB BOGGS,
U.S. Senate,
New Senate Office Building, Washington, D.C.

DEAR SENATOR BOGGS: As President of Sussex Shores Beach Association, an unincorporated beach development of approximately seventy cottages just north of Bethany Beach, I am writing to commend you for persuading the Senate Subcommittee on Air and Water Pollution to hold a hearing on March 26 in Rehoboth Beach on ocean dumping and pollution of the water and beaches in the Delmarva area.

Over approximately the past two years we at Sussex Shores have noticed at decided increase in the tar, oil, bottles, cans, oranges and miscellaneous trash and gunk that is being deposited on our beach area. Until recent newspaper articles appeared indicating that the major source of our pollution problem may be ocean dumping by the city of Philadelphia and certain industrial users, we had thought that Ocean City, Maryland, was one of the major causes of our problem through the dumping of its partly processed sewage into the ocean a short distance offshore. In any event, we would urge that your Subcommittee press for prompt enactment of legislation imposing reasonable controls on ocean dumping of sewage, garbage and other waste materials.

Sincerely yours,

JAY W. GLASMANN,
President, Sussex Shores Beach Association.

[TELEGRAM]

WASHINGTON, D.C.

Senator J. CALEB BOGGS,
New Senate Office Building,
Washington, D.C.:

Bethany Beach Landowners Association comprised of over 300 members endorses your efforts to protect our valuable seashore area by preventing offshore dumping.

WARREN ZITZMANN.

GENERAL FOODS CORP.,
Dover, Del., March 22, 1971.

Senator J. CALEB BOGGS,
Committee on Public Works,
New Senate Office Building, Washington, D.C.

DEAR SENATOR BOGGS: I am writing this to you as a member of the Subcommittee on Air and Water Pollution on the Committee of Public Works.

As Personnel Manager of one of the largest manufacturing plants in the lower Delaware area, I urgently request your Subcommittee on Air and Water Pollution to act favorably on legislation to control ocean dumping, because of its impact on the people employed at this operation.

Many of the nearly 1,900 people who work in General Foods Corporation, Jell-O Division plant located at Dover, Delaware have asked me to write to you of their concern for the protection of one of the major attractions of this area, the availability of ocean swimming and fishing facilities in the Rehoboth Beach section of our State. We urge you to act quickly against the present practice of dumping waste materials which are reported to have contaminated areas so close to our shore.

In addition to their interest in recreation facilities for themselves and their families, their close association with food manufacturing also makes these employees cognizant of another and even more important aspect of the situation. The prevention of further destruction of food resources, in a time of increased awareness of the importance of these valuable high protein sources from the sea, lends even greater impact to your Subcommittee deliberations.

Yours very truly,

C. G. DONNELLY,
Personnel Manager.

Senator Beall submitted the following article for the record:

[From the Washington Sunday Star, Feb. 21, 1971]

WILDWOOD TACKLES OCEAN POLLUTERS

'PAUL REVERE' AT THE HELM

(By Roberta Hornig)

WILDWOOD, N.J.—When Clarence Shoffler spots barges carrying sewage sludge or chemicals out to sea he chases after the tugboat operators, shakes his fist at them and hollers, "Where the hell are you going to dump that stuff?"

Shoffler began his chases about six years ago, three years after the City of Philadelphia began dumping its sewage in the Atlantic, 11 miles out from the mouth of Delaware Bay, and nearer the New Jersey and Delaware coastlines. A few years later Camden and Bridgeton, N.J., started disposing of wastes there, too.

The site—5½ miles off Cape May, N.J., and 7½ miles from Rehoboth Beach, Del., both prime resort areas—was a favorite with clammers. Shoffler had angrily noted his fish and clam catches steadily going down and squarely blames ocean dumping.

In May, when the Food and Drug Administration suddenly declared the sewage site off-limits to shellfishers because of a contaminated ocean bottom, Shoffler, in his own words, "really got mad."

"I tied the boat up for a couple of weeks and started talking around," he said the other night at the Happy Hour, a gathering spot for Wildwood townspeople.

"It's not an easy life to begin with, and when the FDA comes out with a report that there's 120 square miles of ocean in your backyard polluted, then I want to do something about it," he said.

In "talking around," Shoffler, a waterman for 25 years, became the catalyst, a kind of Paul Revere for a small but vocal environmental movement that has become one of the liveliest along the Eastern seaboard.

Officially incorporated as the "Stop Ocean Dumping Association," it's better known by its acronym SODA.

In its short, active life, SODA has:

Got Rehoboth Mayor Lester Johnson to join Wildwood this weekend in asking Sen. J. Caleb Boggs, R-Del., ranking minority member of Sen. Edmund S. Muskie's Air and Water Pollution subcommittee, to hold a hearing in Rehoboth on the ocean dumping. The hearing was requested by the Rehoboth Beach Board of Commissioners.

The immediate goal is to get Philadelphia and Camden and Bridgeton in New Jersey to dump their sewage sludge at least 100 miles off the coast. Ultimately it wants ocean dumping stopped.

Encouraged U.S. Rep. Charles W. Sandman Jr., R-N.J., to force a defunct Bucks County, Pa., plant to dump 3½ million gallons of toxic industrial wastes at least 100 miles out at sea. The plant originally planned to dump the poisons 30 miles offshore from Ocean City, Md.

Obtained 60,000 signatures on a petition to support congressional legislation, sponsored by Sen. Harrison A. Williams, D-N.J.; Sandman, many other senators and representatives, and the Nixon administration, to end ocean dumping as quickly as possible. This is a fairly impressive number considering that Wildwood proper has a population of roughly 7,000.

Moreover, SODA has become a household word in Cape May County, is becoming well known on the Delmarva Peninsula, and the hard core of its 98 members have become instant ecologists, if not oceanographers.

Wildwood is probably one of the few places in the country where President Nixon's ocean dumping report, published by the Council on Environmental Quality in October, has become almost a best seller.

SODA bought 200 copies and got a discount rate—46 cents each instead of the usual 55 cents—because of the number purchased. Waitresses, the mayor, realty agents and clammers quote some of the report's statistics verbatim, from memory, and know exactly the page they want to make a point.

Several clammers have copied from the report the various kinds of ocean dumping sites in the Atlantic, which is the receptacle for an estimated 39 million tons of wastes annually. They show off their own super-sized chart version to anyone who will take a look.

Besides the sewage sludge, the Cape May-Maryland-Delaware offshore area also is a dumping ground for industrial wastes, explosives, toxic chemicals, ammunition and radioactive wastes. These sites, on charts at least, are 100 miles away from the coast-line.

It is the Cape May-Delmarva ocean sewage dump, however, that particularly worries SODA. The Wildwood people fear a second Dead Sea is developing off the East Coast—similar to the only other officially designated contaminated ocean area off New York Harbor.

They are eager to spread the word, confirmed by the U.S. Army Corps of Engineers, that roughly 140 million gallons of sludge, 110 million of it from Philadelphia, is known to be dumped annually near their shoreline.

SODA members also tick off these claims: that Philadelphia's sewage is supposed to be 90 percent cleaned up by the time it hits the Atlantic but that Philadelphia also dumps other kinds of waste ("You name it, they're dumping it"); that Camden's sewage is treated only 25 percent and that Bridgeton's (population about 30,000) gets no treatment at all.

The Wildwood clammers and townsfolk who depend on shellfish and seashore vacationers for a living were well aware of the ocean dumping off their shoreline and had long scoffed at Philadelphia as a "city of brotherly love."

"Humph! I do believe there's another outlet for their sewage other than our back yard. I wonder if they'd be offended if it were reversed," said Wilbur Ostrander, SODA's president and Wildwood's commissioner of public works.

But it was only last July 10—nearly two months after FDA closed the shell-fishing grounds—that Don Long, head of the town's clam processing company was officially notified that the ocean area was contaminated and was ordered to spread the word.

It took two more months for the SODA people to get their organization off the ground.

After brooding for weeks, Shoffler in early October went to Capt. Otto Stocker, owner of the towns cruising boat, to discuss the contamination that is forcing clammers to move out further to sea or down the coast.

Then Stocker, Long and Ostrander met in Long's office and Ostrander arranged a boat trip to the sewage dump site for area officials and news media.

From the ocean bottom they dredged up, for all to see "thousands of dead clams" and what in polite circles is called "Black muck."

The hard-core group—which by then had grown to include Wildwood Crest's mayor, Joseph Von Savage; realty agent Joseph Olwell; Anthony Bianchi, head of the Greater Wildwood Hotel & Motel Association; Mrs. Eleanor Hughes, a printer; and several watermen—then decided it needed a quickie course on ocean ecology.

On Nov. 18, a "marine conference" was held at the Lobster House, a Cape May restaurant. Guests included university oceanographers, New Jersey scientists, an FDA representative, members of the State Department of Environmental Protection and the director of the Shellfish Institute of North America.

In the words of a recently drafted "History of the Stop Ocean Dumping Association":

"Then Ostrander crossed the Delaware Bay and carried the word to the states of Delaware and Maryland."

A week ago, Rehoboth Beach joined. "They've got a good thing going and we're behind them," said Mayor Johnson. "Our only asset is our beach. If that one mile goes, we may as well close shop."

Ocean City, Md., officials are in the process of deciding whether to join up.

Even though its activism is still relatively new, SODA members are now philosophically confirmed environmentalists. They are beginning to question what they had unskeptically accepted in the past.

For example: the closing down three years ago of a once-booming menhaden processing plant in Wildwood.

According to clammer Shoffler and Eirik Kirkeberd, who owns the Wildwood fishing boat dock area, the once-abundant menhaden, used for bait or converted into fertilizer, have just about completely disappeared from catches offshore Cape May County. They also report that they have been catching flounder and sea bass with "big sore rings around their fins, and with tails looking like somebody chomped on them."

"It's something out there that's doing it," Shoffler said, shaking his head.

The watermen also are beginning to question what's happening to fish in the "back creeks," the Jersey Meadow spawning grounds up and down the coast.

"In the ocean, if the fish don't like it, they go someplace else. But in the back creeks, you get fish kills," Shoffler said, and Kirkeberd agreed. In their own minds, they have decided that past pesticide spraying to kill meadow mosquitos is behind the disappearance of several species of fish.

Long produced statistics which seemed to confirm the watermen's theory, at least in part. In the last year, New Jersey has lost 1,671 acres of back creek and estuary areas because of pollution.

Shoffler calls the sewage dumping site "sheer idiocy."

"What really got me is that this area was 70 percent clam bottom and 40 percent of that was clam seed. They buried those poor things alive," he says.

"The mouth of any bay . . . it's like a fertile valley where things grow. That's a desert out there now."

In 1963, Shoffler says, his boat was taking on 2,000 to 3,000 pounds of fish a day. In the last few years, the catch has dropped to 700 to 800 pounds.

In 1963, he says, he had \$30,000 worth of lobster pots trapping 100 pounds a day. "Now you just don't see them," he said.

Clams are still on the ocean bottom, but Shoffler and the others are worried about their susceptibility to pollutants.

There are no restraints now on ocean dumping beyond the three-mile territorial limit. This is what SODA wants changed quickly. Its ultimate goal is a complete halt to putting wastes of any kind in the sea.

"Sure we want that sewage to go out 100 miles now. But even if we get those towns to take it out farther, what will it do to the new area? There's life out there, too," one SODA member said.

Up to the last month, the Wildwooders operated on a pretty much out-of-pocket basis, with individuals paying their own way to "sell" Rehoboth Beach, set up the marine conference, visit the Bucks County chemical plant and to buy newspaper ads.

Since incorporating as a non-profit organization January 14, SODA has built up a kitty of \$3,000, all of it from membership dues of \$5 to \$250. The smaller amount comes from individuals. The larger comes from the Wildwood Junior Chamber of Commerce and Rehoboth. Eventually, the group hopes to get contributions in the \$1,000 range.

"Our original purpose was to combat local problems—to inform, educate, persuade and seek passage of effective laws which will ensure that our sea life in every form is not annihilated," realtor Olwell says.

But now SODA sees its mission as changing. "We now recognize the significance of the ocean dumping problem, off the Gulf and Pacific coasts as well as ours," Olwell says.

With its small budget, the new environmentalists are setting out an ambitious program.

Working out of "Eleanor's house" (Mrs. Hughes), Ostrander's office at the city hall or the Happy Hour, SODA is averaging a mailing list of 300 "alert" letters a day. Its current project is sending literature to 10,000 in the next county up, Atlantic.

Next it plans mass mailings on the "down counties" on the Delmarva Peninsula.

"We plan to go up and down the coastline, a county at a time. When we're finished on the East Coast, we'll work our way around the Gulf and up the Pacific. Heck, we might even call a national convention," Ostrander says.

The following series of articles from the Newark, N.J., Star-Ledger was submitted to the subcommittee staff for inclusion in the record:

[From the Newark, N.J., Star-Ledger, Mar. 21, 1971]

A "DEAD SEA" AT THE JERSEY SHORE

Every day, New York City's fleet of five sludge barges races back and forth between New York's obsolete sewer plant and the Sandy Hook ocean dumps off the Jersey Shore.

Each day the ships empty about four million gallons of liquid sludge 12 miles from Jersey's beaches, each of the five ships making two trips daily.

The sludge is so putrid and rank that you can see it, smell it and some crew members on the decks have been known to throw up while the ships are disemboweling.

The poorly treated sewage oozes out of 12- to 18-inch pipes along the ship's bottom, a flushing that takes some time since each ship holds between 350,000 and 500,000 gallons of industrial and human wastes.

A trail of brown and black bubbly streaks is clearly visible behind each sludge barge as they circle the 22-square-mile dump near Ambrose Lighthouse, before nosing back to New York.

(By Gordon Bishop)

The once-sparkling Jersey Shore is rapidly becoming a "Dead Sea" as billions of gallons of raw sewage and sludge daily pour into the Atlantic Ocean, killing fish and creating a serious health hazard for the millions of vacationers who swim in the surf every summer.

The problem has become so acute that a marine ecologist conducting studies of oceanic pollution for the federal government has forbidden his children to play in the surf at Sandy Hook State Park, the Garden State's largest public beach.

Since tourism is New Jersey's biggest moneymaker, pulling in more than \$2 billion a year—most of it from shore activities—state officials are now alarmed over the very distinct possibility that it will all go down the drain if the waters off New Jersey become unsafe and eventually unfit to swim in.

In fact, 88 per cent of all ocean dumping around the United States occurs along the Jersey Shore, according to Thomas M. O'Neill, executive administrator in the State Department of Environmental Protection.

The Jersey beaches are being invaded by rampant pollution from several sources:

A half-billion gallons of raw untreated sewage daily from Manhattan via the Hudson River.

Six sludge, chemical and junk dumps covering a 22-square-mile area off Sandy Hook.

At least 25 municipalities along the Jersey Shore, most of them catering to tourists, piping poorly treated sewage and sludge into the ocean only 1,000 feet or less from their beaches.

A vast sludge and chemical dump off Cape May for waste disposal from Philadelphia, Baltimore, Camden and Delaware.

Hundreds of factories belching effluence into rivers that have been long condemned for fishing and swimming.

Pleasure ships that flush their fuel tanks before entering the New York Harbor, resulting in thousands of black, oily balls strewn along the shore.

The independent sewerage authorities have been using the Jersey Shore as their own private "out-houses" for the last 40 years. But the practice was ignored until only recently, when state officials realized that unless all dumping stopped in the next two or three years, the renowned Jersey Shore—one of the state's greatest economic assets and resources—would be off-limits for people.

State environmental officials, however, already have faced up to the grim fact that no significant relief is in sight for five years, at the earliest.

By then, New Jersey and New York City officials hope to have at least half the sewage flow under control, but it may be too late at the rate industrial and human wastes are multiplying, observed federal marine ecologist Dr. Jack Pearce, the government's chief researcher at Sandy Hook Marine Laboratory.

As secondary water treatment plants begin operating around 1975, they will be producing mountains of sludge (treated sewage) which are now barged out and dumped in the ocean 12 miles offshore. The more efficient the treatment plants become, the more sludge is generated.

"We're trapped in a vicious economic ecological cycle," Dr. Pearce declared. "And there is no way out of it in the foreseeable future."

And as the condition worsens, people will become more and more exposed to a myriad of viruses.

"More people are suffering from middle-ear infections than ever before because of swimming in polluted water," Dr. Pearce revealed. "I won't let my daughters swim at Sandy Hook because the water is marginal—and 20,000 people swim there every day in the summer, many of them becoming nauseated."

Huge sections of Barnegat Bay have been condemned for shellfishing and three-fourths of Cape May's bay waters have been closed down for fishing for several years.

"Humans become susceptible to any disease originating from fecal matter absorbed by the shellfish, so we're forced to condemn entire areas of the shores and bays," disclosed Richard Bellis, chief of the Bureau of Shellfish Control in the State Department of Environmental Protection.

"It's seriously hurt our shellfish industry, which is the second major producer of claims in the country," Bellis noted.

The condition has become so visibly disgusting that the Federal Water Quality Administration can now judge the bacterial level of coastal waters on any given day by checking their "Toiletry Index," which counts the number of hygienic toiletry accessories that can be found floating on the surf or littering the beaches.

"It's something none of us wants to talk about or even pretend to admit, but it's there and it's ugly and we can no longer hide the fact that we are all living and playing in our own filth," complained Richard Dooling of the FWQA's office in Edison.

"Whatever man uses for his necessities or pleasures can be seen accumulating along the shore," Bellis said.

The once-healthy and refreshing water is never blue or clear any more—it ranges from gray to brown, or as one observer aptly put it, "dung-colored year-round."

Transforming the Jersey shore into a supercesspool took a lot of doing by everyone.

All the pleasure ships for example, do not have to purge their huge fuel tanks near the beaches, as they wend their way back to New York. But they do it because no authority has ever properly enforced the 1888 Navigable Waterways Act which prohibits such dumping.

On their return trips from the islands, the ships load their empty fuel tanks with ocean water so the passengers will have a smoother ride. A light empty ship bobs with the waves. But when the tanks are flushed, black glop oozes out and coagulates into the familiar bilge balls Jersey surfers often have stepped on or rolled in on the sand.

The slick balls also are discoloring the beaches. It's almost impossible today to see any bright, sparkling beige sand; it's now brown, and in some areas black.

Immediately affected have been the fish, which are drowning in man's pollution.

The sludge dumps off Sandy Hook have obliterated all marine life. The "Dead Sea" already has taken its toll of 17 species of fish.

* * * * *

The popular blue fish and weak fish are suffering from fin rot disease. It has reached epizootic proportions in species in the Raritan Bay and Sandy Hook Bay area.

Winter and summer flounder also have been seriously infected, as many as 30 percent of their population during the months of July and August.

As a result of fin rot, fish become sluggish and are unable to move swiftly through the water. The slower they move, the less water passes through their gills and the less oxygen gets to them. Pollution removes oxygen from the water so the healthy fish must move faster to get more of it. The unhealthy fish gradually suffocate.

The sludge dumps also are affecting the fish's migrating patterns, forcing them farther and farther away from the Jersey Shore in search of fresh water and clean spawning beds.

Moving the dumps 100 miles out, as suggested by Gov. William T. Cahill, is not the solution, according to the newly-established Environmental Protection Administration in Washington.

* * * * *

"No matter where you push the dumps today, the tides and currents will bring it back on us eventually," an EPA official said.

While the spreading coastal dumps remain an ever-increasing threat to the welfare and future of the Jersey Shore, relief can be expected from the more gross polluters who now empty their wastes in their own backyard.

Work on New York City's \$300 million Riverbank Plant began last fall. The sprawling secondary water treatment plant will cover the riverbanks between 137th and 145th Streets. The plant is scheduled to go on stream by 1975, if no major obstacles are encountered.

Riverbank is designed to operate with 90 per cent water purification efficiency. Until the plant goes to work, however, all of Manhattan's West Side wastes will continue to gush into the Hudson River, where the tides and currents drag the stinking sewage under the Verrazano Bridge and down along the Jersey shore—a half-billion gallons a day, every day, drifting to Jersey's vacationland.

Jerseyans are no less at fault. They guiltily confess to their role in accelerating beach blight and oceanic pollution.

Shore municipalities will be required to shut down their sewerage operations when the state's regional secondary water treatment plants start up in 1975, or sometime shortly afterwards.

The discouraging—and disgusting—view of the shore polluters is that they're destroying their greatest economic asset, state environmentalists say. They lure tourists to their browning beaches and then force them to swim in their own sewage.

* * * * *

The State Board of Health files bulge with complaints. They show the biggest shore resorts are the biggest polluters. The open ocean cesspool begins at Sea Bright and extends to Beach Haven.

Of the 25 or more communities discharging their wastes a few hundred feet from the surf, the state cited the worst offenders, listing each operation by its capacity:

Long Branch Sewerage Authority—2.5 million gallons per day.

Dover Township Sewerage Authority, Ortley Beach Plant—2.5 million gallons.

Long Beach Township Sewerage Authority—2 million gallons.

Borough of Seaside Heights—1.7 million gallons.

Borough of Point Pleasant Beach—1.5 million gallons.

Borough of Spring Lake—1.5 million gallons.

Ship Bottom Sewerage Authority—1.2 million gallons.

Borough of Seaside Park—1 million gallons.

Borough of Lavallette—800,000 gallons.

Borough of Surf City Sewerage Authority—700,000 gallons.

Beach Haven Sewerage Authority—600,000 gallons.

Borough of Bay Head—500,000 gallons.

Borough of Spring Lake Heights—500,000 gallons.

There are 12 or more other communities polluting the ocean, but their operations are less than half-million gallons daily, according to Robert Vincent, supervising water engineer with the Department of Environmental Protection.

* * *

In an effort to save the oceans before they meet the same fate of a Lake Erie or a Newark Bay, the federal government is holding its first public hearing this month on the devastating effects of ocean pollution. Three-fourths of the world's oxygen supply comes from life in the ocean that is gradually dying because of pollution.

New Jersey Commissioner Richard J. Sullivan of the Department of Environmental Protection is scheduled to testify on shore pollution March 26. The hearings, which are set to begin 9:30 a.m., will be held at Rehoboth Beach, Del. U.S. Sen. Edmund V. Muskie (D-Me.) will conduct the proceedings.

Muskie has drafted a senate bill which would ban ocean dumping as quickly as possible.

An aide to Senator Muskie labeled the Atlantic Ocean area off New Jersey-New York a "Dead Sea."

If all dumping and discharging were stopped today, it would take 10 to 20 years for the ocean to cleanse itself and return to its natural state, oceanographers estimate.

[From the Sunday Star-Ledger, Mar. 21, 1971]

JERSEY POLLUTION HOTLINE IS A BUSY NUMBER

(By Gordon Bishop)

Citizens wanting to complain about any form of pollution, be it the stench of garbage or sudsy tap water, can now call New Jersey's Environmental Action Line in Trenton.

The number is 609-292-7172.

Since the line opened Oct. 22, more than 500 complaints have been received by the environmental operator, Mrs. Mary Kelly, who works for the State Department of Environmental Protection.

Most of the calls come from North Jersey, which, as part of the metropolitan area, suffers the greatest amount of pollution than anywhere else in the country.

Air pollution ranks three to one over water pollution complaints tallied thus far. Then dropping off by a considerable margin are complaints on solid waste disposal and dredging, each of which represent only 2 per cent of the calls.

Miscellaneous complaints account for another 2 per cent of the calls, anything ranging from noisy neighbors to uncurbed dogs.

Mrs. Kelly refers all inquiries that warrant an investigation to the department's various antipollution chiefs.

Since more than 90 per cent of the complaints originate in North New Jersey's four counties—Essex, Bergen, Hudson and Union—state inspectors are literally working around-the-clock chasing down alleged polluters. A few of the state's "gross polluters" operate at night, where the black smoke and soot from their stacks often go unnoticed.

Residents directly affected by a possibly hazardous condition receive priority treatment from the state. Sometimes, however, several months or years may pass before a pollution problem is corrected to the satisfaction of both the state and affected citizens.

After nearly five years, a Wood-Ridge family is still trying to stop air pollution from a neighborhood factory. The case remains in a Bergen County court, languishing under a series of postponements and seemingly endless warnings from the judge.

"If nothing else, we're closing in on the reckless polluters—their days are numbered," observed Tom Leonard, head of the state's air pollution enforcement division.

All callers to the Action Line also receive an Actiongram from the state, which signs off with, "Environmental problems will only be solved when government and individual citizens can work together in this way."

[From the Star-Ledger, Newark, N.J., Mar. 22, 1971]

ARMY OPERATES HUGE POLLUTION PROGRAM

(By Gordon Bishop)

The powerful Army Corps of Engineers, which issues all permits for ocean dumping off the Jersey Shore, strenuously objects to its own operations, but the Corps is under orders to continue, indefinitely, the world's largest pollution program.

The United States Congress has, by law, empowered the Corps to issue permits for the dumping of sewage and toxic chemicals until the government can find an alternate method of disposal. That might not be for another five to 10 years, or longer.

Meanwhile, the once-invigorating Jersey Shore environment is rapidly dying from massive overdoses of every kind of pollution imaginable. Every type of chemicals and elements, natural and synthetic, plus all of the megalopolis' human wastes, can be found off the Jersey Shore.

The largest contributor of sludge (treated sewage) at the ocean dump 12 miles off Sandy Hook is New York City. "It's responsible for more than half of all the wastes dropped off the Jersey Shore, or more than a half-billion gallons a year. This does not include the half-billion gallons of raw sewage now pouring into the Hudson River every day.

Not far behind are Jersey's own obsolete sewerage treatment plants. Topping the list is the Passaic Valley Sewerage Treatment Plant in Newark, which "poorly" processes most of North Jersey's wastes, both residential and industrial.

Modern Transportation Co. in South Kearny, which barges out sludge for six major sewerage authorities, unloads more than a quarter-billion gallons a year.

A billion gallons of sludge were dumped at the 22-square-mile site off Sandy Hook last year—and that figure will double within the next five years, according to Major Robert S. Lindsay, assistant district engineer for the Army Corps of Engineers.

More and more mercury and copper also are being discharged in the ocean because sewerage plants are not engineered to separate harmful chemicals or elements from industrial wastes.

"It's all called sludge," Major Lindsay said in an interview with The Star-Ledger.

Like many environmental experts "in-the-know," Major Lindsay is not optimistic about man's ability to overcome the pollution problem. It involves "too many people, too much consumption and man's refusal to start recycling his vanishing resources," Lindsay opined.

"There are no discernible efforts on the part of any municipality in the New Jersey area to institute land disposal," Lindsay pointed out. "The Corps can only conclude, therefore, that ocean dumping will persist, possibly for many years—unless our citizens can exert enough influence to change the methods."

Although the Corps tries to enforce the 12-mile limit for dumping off the Jersey Shore, it often has been accused of allowing barges to begin "bleeding out" their sludge only a couple of miles off shore, aggravating the health hazard considerably more.

The State Department of Environmental Protection claims the Corps possibly can't follow every barge that leaves the metropolitan area to see if they take the sludge out to the full 12-mile limit.

The Corps rejects such charges, referring to its sundry methods of detection, including radar, which allegedly keeps barges and ships under constant surveillance.

The sludge dump off Cape May has absolutely no enforcement or control, Major Lindsay disclosed. Under the jurisdiction of the Philadelphia District, the Cape May dump is "anywhere beyond the three-mile limit." The Philadelphia District has no enforcement powers beyond that.

* * * * *

In fact, the barge companies tell the Philadelphia District how far out each load went and the district files the barge report without further ado.

That end of the Jersey Shore also must tolerate the Cape May City Sewerage Treatment Plant, which runs at over-capacity and pours practically raw sewage into the bay, according to Richard Bellis, chief of the Bureau of Shellfish Control for the State Department of Environmental Protection.

South Jersey is the dumping site for both Philadelphia and Baltimore and much of Delaware.

The state is now conducting a survey to determine whether membership in beach clubs are declining as a result of the worsening condition.

The decision to use the "free and open" ocean off the Jersey Shore to get rid of all the metropolitan wastes was made in 1924 by an act of Congress.

The supervisor of the New York Harbor (then a Naval officer) was given the responsibility of establishing and policing offshore dumping limits. This was done to insure that sludge barges would not maneuver in congested shipping areas and would not dump in a location where ocean currents could carry the unsightly material to the shores of either Long Island or New Jersey.

When the original point was selected in 1924, it was assumed the site would last for a hundred years. But population growth figures far outdistanced federal planners' estimates. And there was no way of accurately predicting how many communities would install sewerage plants that produce sludge.

In 1953, when the Corps took over the duties of supervisor of the harbor, it became concerned about the growing volume of sludge being dumped in the ocean.

Elementary testing every two or three years showed the sludge area was spreading, although not yet at an alarming rate. Tests for bacteria were negative three miles beyond the limits of the area.

In 1967, the United States Public Health Service, in cooperation with the Corps, conducted more extensive testing. Health officials reported it found no harmful bacteria beyond a six-mile radius from the dumping point.

The Corps decided that a broader and more exacting investigation should be made. In 1968, the Corps secured an elite scientific committee of the Smithsonian Institute. The Sandy Hook Marine Laboratory was selected to make the study for the Corps of Engineers.

The Marine Sciences Research Center of Stony Brook, Long Island, also participated in the project.

On Dec. 1, 1969, at about mid-point in the study, an interim report was submitted by Sandy Hook. The report was leaked to the press and a flood of public clamor followed, demanding that the sludge dumps be moved further out to sea.

Since the investigation was only half-complete, the Corps consulted a couple of reputable scientists on ocean pollution for a preliminary judgment.

Dr. Bostwick H. Ketchum, associate director of the Woods Hole Oceanographic Institution in Massachusetts, recommended that "disposal operations continue . . . to permit a further evaluation of the accumulation and spread of the deposits."

Dr. M. Grant Gross, research oceanographer, Marine Sciences Research Center, and associate professor of oceanography, State University of New York, commented:

"Considering our lack of knowledge and the possible long-term effects from the deposition of wastes, I cannot, at this time, support the proposal that the disposal areas be moved farther offshore. We may simply be creating another problem on the continental shelf."

The Corps was left to resolve the dilemma by itself.

"None of our self-appointed advisors have told us where to move the out-house," Major Lindsay said.

To dump beyond the continental shelf, or 100-mile line, is to play a sort of ecological life-death game.

"We have been warned by eminent scientists that no one knows what is down there (continental shelf depth)," Lindsay explained. "We may destroy the essential marine organisms that are the basis of all marine ecology. We also will be putting the sludge into a deep freeze, preserving it and its possible destruction for a thousand years."

While the "experts" continue to study and argue about the consequences of ocean dumping, the "Dead Sea" area grows larger and larger—and filthier.

With mountains of sludge to be disposed of in the coming years from the new sewerage plants now on the drawing boards, the need for an alternate method of getting rid of wastes must be devised immediately . . . or the Jersey Shore will be buried under a sea of sewage in the coming decades.

[From the Star-Ledger, Newark, N.J., Tuesday, Mar. 23, 1971]

WASTE TREATMENT: SLUDGE GULPING MACHINE FEASTS ON LEFTOVERS

(By Gordon Bishop)

Alternatives to ocean dumping already exist, but state and federal governments have so far failed to employ any of them to stem the rising tide of pollution along the Jersey Shore.

Before ocean dumping can be banned forever, the government must commit its vast resources to developing existing incineration and reclamation programs immediately.

The nation's first commercially successful sludge-burning incineration operation began last year in rural Gloucester County.

Plunked down in the middle of peaceful, rolling farmlands in remote Logan Township is the innocuous "Sludge Gulper"—a promising technological solution to processing man's infinite wastes.

The Sludge Gulper devours toxic chemicals, oils, phenols, resins, plastics, digested sewage, solids—and lots more—and it doesn't even leave a faint trace of environmental pollution.

The Sludge Gulper is the symbol (A ferocious-looking orange elephant) of a complex process of waste disposal, involving settling lagoons, storage tanks, separators, conveyor belts and one of the most efficient incinerators in the state, according to the records of New Jersey's health officials.

The creation of Rollins-Purle Inc., Wilmington, Del., the Sludge Gulper is ready and waiting to ingest all the junk and garbage now being dumped in the ocean.

"So far, state and federal officials have only looked approvingly at our operation—and remained silent on commitments," remarked Edward Davis, Rollins vice president of corporate relations.

But the official silence and stagnation haven't deterred John W. Rollins, who plans to build 100 waste treatment plants throughout the country by 1975.

Davis said his company would be capable of developing a Master Plan of regional incineration sites for the state, if officials are seriously interested in ending ocean dumping.

The only parties taking advantage of the 250,000 gallon-per-day Sludge Gulper are the giants in industry—Du Pont, Esso and IBM. "And they're doing it out of environmental necessity," Davis said. The Sludge Gulper takes what nobody else wants."

Rollins plans to scale-up his operation as business increases (it's at a break-even level now), or as "more people become alarmed over the deterioration of the environment."

* * *

The Sludge Gulper has been doing the most difficult environmental task of all while still in its infancy: Neutralizing and separating harmful substances before disposal in the smokeless incinerator.

It is also recycling resource by salvaging materials separated on a conveyor belt. Pure copper and nonferrous metals are recovered, instead of being buried in a garbage dump or dumped in the ocean.

In addition, the Sludge Gulper purifies solvents for reuse.

* * *

This is the ultimate answer to today's environmental quandary, according to Commissioner Richard J. Sullivan of the State Department of Environmental Protection.

"We just can't keep throwing away everything we have," Sullivan has repeatedly warned. "Recycling is the only hope for the planet: Its resources are finite—not endless."

Rollins' towering incinerator meets the state's strict air pollution requirements.

The mayor of Logan Township, who owns a rambling farm next to the silent Sludge Gulper, has often complimented Rollins for his "clean operation," despite the highly toxic and noxious chemicals that are treated there around-the-clock.

The Sludge Gulper requires several hundred acres of living space to minimize any possible nuisances.

Rollins plants are now going up in Houston and Baton Rouge, where they petroleum and petrochemical industries are in desperate straits over what to do with their offensive wastes.

Rollins also is checking out a possible site in North Jersey's Hackensack Meadowlands, where the state is developing a unique supercity which is expected to blend in compatibly with the marshy environment.

The other alternative to ocean dumping is soil reclamation. While there are certain inherent risks in spreading sludge and sewage over unproductive land (contamination of the subsurface watertable, for example), it is nevertheless an idea whose time had come.

Last year, the federal Department of the Interior instituted a \$2 million reclamation pilot program in Muskegon County, Michigan. Rather than disposing its "undesirable" wastes in the nearest stream or lake, Muskegon County viewed its sewage as "valuable" resource which, when used for irrigation on marginal farmland, may solve the expensive disposal problem and add to the economic development of the area.

The "Return-to-Nature" system involves the collection and primary treatment at several points in the county of the entire output of 32 million gallons of sewage. Primary treatment consists of removing rocks, sticks and other objects.

The sewage, or wastewater, is then piped to a central point for treatment in oxidation lagoons where bacteria consume organic wastes. One lagoon is 30 acres, the other 40. * * *

Disinfection facilities and two storage lagoons, each 600 acres, complete the total waste management system. The storage lagoons provide for containment of the wastewaters during periods when irrigation cannot be performed and also provide additional treatment.

More than 10,000 acres of marginal land are then irrigated by the wastewater, where the nutrients seep into the soil for use by plants.

The nitrogen, phosphate and potassium content of the sludge is approximately equal to that of commercial fertilizers used for corn, soybean and alfalfa.

The end product of the massive environmental project is, of course, profit. A bumper crop of marketable agricultural products would pay off the investment, with profits from the next harvests then going into the farmer's pocket, or shared with the government.

If the Muskegon County experiments work, similar projects will be established in the regions of the country where pollution is a critical problem.

To alleviate the ocean dumping off the Jersey Shore, the sludge from Philadelphia and New York City could be piped to unproductive land in Pennsylvania and upstate New York, respectively.

Jersey's wastes could be reclaimed by the Sludge Gulper, if no land is available for soil reclamation.

The techniques are available, waiting for state or federal governments to act

(This section contains additional materials compiled by the subcommittee staff for inclusion in the record.)

PROPOSAL BY OCEAN ENVIRONMENTAL ENGINEERING CO. AND TOLLEFSON ENTERPRISES INC.

Transportation of sewage sludge from New York and Delaware River regions to a designated area beyond the Continental Shelf.

SUMMARY

Subject

1. Transportation and disposal of sewage sludge and wastes beyond the continental shelf as an interim solution, to minimize ecological damage, while research and development of alternate methods for the elimination of ocean dumping are in progress.

Problem

1. Pollution and contamination of estuarine and shallow near water coastal areas adjacent to the New York Bight and the Entrance to the Delaware River created by present modes of waste disposal.

2. Effect on economics of multi-billion dollar residential, recreation and vacation areas in coastal regions.

3. Effect on ecology and economics of marine fisheries supported by the shallow near water coastal regions.

Intent

1. To show economic and logistic feasibility of transportation by self-propelled ships to a designated deep water area, common to all sources of sewage sludge, for control and monitoring by appropriate agencies.

Suggestion

1. The sources namely, The Greater New York-New Jersey Metropolitan Area and the Delaware River and Bay Regions be combined as the East Coast Central Disposal Region.

(a) This would supply the volumes necessary to maintain unit costs consistent with or less than rates established by contract in areas presently served by private carrier.

2. Designate one deep water area beyond the thousand fathom curve to serve as a common disposal site for all sewage sludge and wastes generated in the region.

Proposal

1. Ocean Environmental Engineering Co. will provide ships with sufficient speed and capacity to efficiently and economically transport sludge and wastes

from regional sources, presently using ocean dumping, to a designated common deep water disposal site.

Topic

To provide dependable, efficient, economic transportation of sewage sludge to an area beyond the continental shelf in an effort to begin environmental control and prevent further ecological damage and contamination of beaches and estuarine waters adjacent to the present inshore disposal areas.

References

H.R. Publication 15915—Hearing Before Subcommittee on Rivers and Harbors at Sandy Hook February 23, 1970.

Ocean Dumping A National Policy

Coast and Geodetic Survey Charts: 1215, 1219, 1000, 1108, 1109.

Discussion

Because of the overwhelming interest in health hazards created by environmental pollution, resulting from disposal of man made wastes, we are entering into this discussion of an solution to reduce or eliminate further contamination of shallow coastal and estuarine waters. The states of New York, New Jersey and Delaware are most concerned with the ocean pollution problem because of the common practice of dumping sewage sludge in the coastal waters contiguous with their shores. This sludge is generated by the City of New York, various New York and New Jersey communities comprising the Greater Metropolitan Area and Philadelphia, Camden and Bridgeton bordering on the Delaware River. It is presently transported to the disposal areas in small motor tankers or tug-barge units. This practice has contributed to the contamination of the New York Bight area and is rapidly creating the same condition at the entrance to the Delaware River as evidenced by the action of the Food and Drug Administration in restricting the area to shellfishing. In the Northern area the condition is so severe the term "Dead Sea" was created to describe the disposal site.

Research by Department of Interior scientists using surface and bottom drifters indicates that tidal currents carry sludge particles to both New York and New Jersey coastal areas which are densely populated residential, recreation and vacation centers. The coastal tidal action is such that it traps rather than disperses the pollutants and has created an area of such concentration that it has affected the ecology and environment conditions of the local waters. Inevitably it will take a few years to develop satisfactory alternate on-land sludge disposal facilities. While research and development of other methods is in progress an interim measure should be adopted requiring all sewage sludge be dumped beyond the continental shelf. Dumping beyond 100 miles off-shore prevents return of waste and contaminants by tidal action.

The proposed dumping area approved by Doctors Walford and Pearce of Sandy Hook Marine Laboratory is a Corps of Engineers site bounded by Latitudes 38°47'N to 38°57'N and Longitudes 72°17'W to 72°30'W which is approximately equidistant from the Lower New York Bay and the entrance to the Delaware River with an average depth of 1200 fathoms (7200 feet). These greater depths and uni-directional current would provide dispersion over a larger area thus reducing concentration and increasing dilution. This would result in an improved biological digestion, increased oxidation and neutralization of residuals to a point where the environmental threat is minimized. The revenue of recreation and vacation areas jeopardized by present modes of waste disposal is four to six billion dollars annually without consideration of the ecological and financial losses to marine fisheries.

If dumping at shallow inshore sites is curtailed or completely prohibited, the present contaminated areas will begin to regenerate while research and development is in progress to a more sophisticated method of disposal at a shoreside installation designed to completely eliminate ocean dumping.

By requiring all wastes developed in the region to be disposed of in a common deep water area controls and monitoring consistent with proposed legislation can be maintained.

Present practices

Transportation is by small Motor Tankers or tug-barge units to the designated shallow near water areas.

The City of New York through its Environmental Protective Agency operates: four 1600 ton Motor Tankers and one 3200 ton Motor Tanker.

These vessels operate on a daily basis to the designated disposal area transporting approximately two and a half million tons per year. Other cities and municipalities within the New York Metropolitan Region use a tug-barge service provided by private contractors transporting another two and a half million tons annually to the same areas.

Suggestion

Considering all coastal areas the volumes involved in this region with the greatest density of population makes the situation most acute. With this being a joint problem affecting a number of states the development of an interim solution should be established on a regional basis serving the Greater New York-New Jersey Metropolitan Area and the Delaware River and Bay Regions to provide the following advantages:

1. Economy: By combining sources of sludge to advantageously utilize the speed and capacity of the ships in transporting to a deep-water disposal area a substantial economic advantage can be realized.
2. Dependability: Less possible loss of time for weather. (Coast Guard testimony revealed that the present methods lose approximately 30% of time for weather and if required to go 100 miles beyond inshore areas would suffer 50% loss of time and productive capacity for inclement weather.)

Proposal

Ocean Environmental Engineering Company will provide ships specially converted to be consistent with the handling characteristics of the cargo material for the transportation of sewage sludge presently being dumped at sites in the entrances to Lower New York Bay and the Delaware River to an approved designated area beyond the continental shelf. The suggested site is approximately equidistant from the present dumping areas with an average water depth of 7200 feet.

Each ship will have a capacity of 10,000 tons with a sustained sea speed of 15 knots (17 MPH) with the obvious advantages of speed, greater capacity than present vessels and dependability (no loss of time for weather). After a careful analysis of contract rates in the aforementioned areas a substantial economic advantage is also realized.

The conversion of the vessels will provide tanks with flat bottoms and a minimum of internal obstructions to facilitate cleaning. (The double bottom construction will also prevent water contamination by spilled cargo if the ship is accidentally grounded and holed.) A fixed Butterworth System will be installed so that tanks can be flushed and cleaned with each dumping operation. Each compartment will be provided with submerged vertical solids pumps to insure the complete stripping and cleanliness of the tanks.

A bow thruster will be installed to improve maneuverability.

A sophisticated electronic system will be installed to pinpoint location in the designated spoil area regardless of weather or sea condition.

This is offered on a regional basis to keep the price structure at an attractive level and justify the sophistication of the equipment and operation.

Two ships of 10,000 ton capacity will be required to efficiently service New York City with its present output. To efficiently utilize the productive capacity, with respect to economics, a minimum of twelve trips a month will be required.

One ship on an intermittent basis will serve the Delaware River area and also serve as a back-up for New York.

The first ship could be operable within ninety days of contract with a second available for service within 150 days.

Feasibility study

To Ocean Environmental Engineering Co., subsidiary of Tollefsen Enterprises, Inc., New York, N.Y.

1. To survey and evaluate certain problems that would generate from the decision to dump sludge beyond the Continental Shelf.

A. Loading facilities.

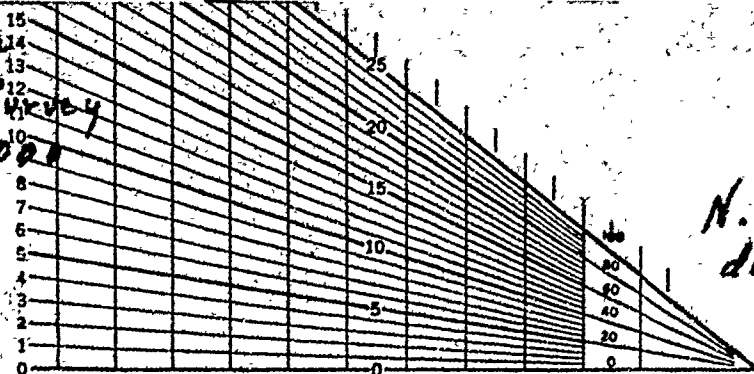
B. Transportation.

2. Utilization of present New York City Department of Public Works Sludge Tankers:

The presently engaged ships would effectively be used, without personnel or union changes, as supplementary storage and feeder vessels. They would continue to service outlying plants inaccessible to the larger ships. Then upon being loaded would proceed to the deepwater loading berth, at one of the other disposal plants, for offloading into the large oceangoing ship. Upon completion it would proceed to another plant requiring supplementary storage and transportation. This would assist tremendously in eliminating the outfall of raw or semi-processed sewage, from overloaded or inadequate plants, into the Hudson River and New York Harbor.

It would not be economically feasible to use these small ships for direct transportation to the area of the Continental Shelf because with the distance involved their productive capacity would be reduced by 60 percent. They would also have to be modified for inspection and certification to navigate in international waters.

U.S. Coast
Geodetic Survey
Chart No. 1000



N.Y. Harbor to
disposal Area
140 Miles Naut.
161 " Stat.

Scale: 1" = 16.5 Miles Naut.
18.99 " Stat.

LORAN LINEAR INTERPOLATOR

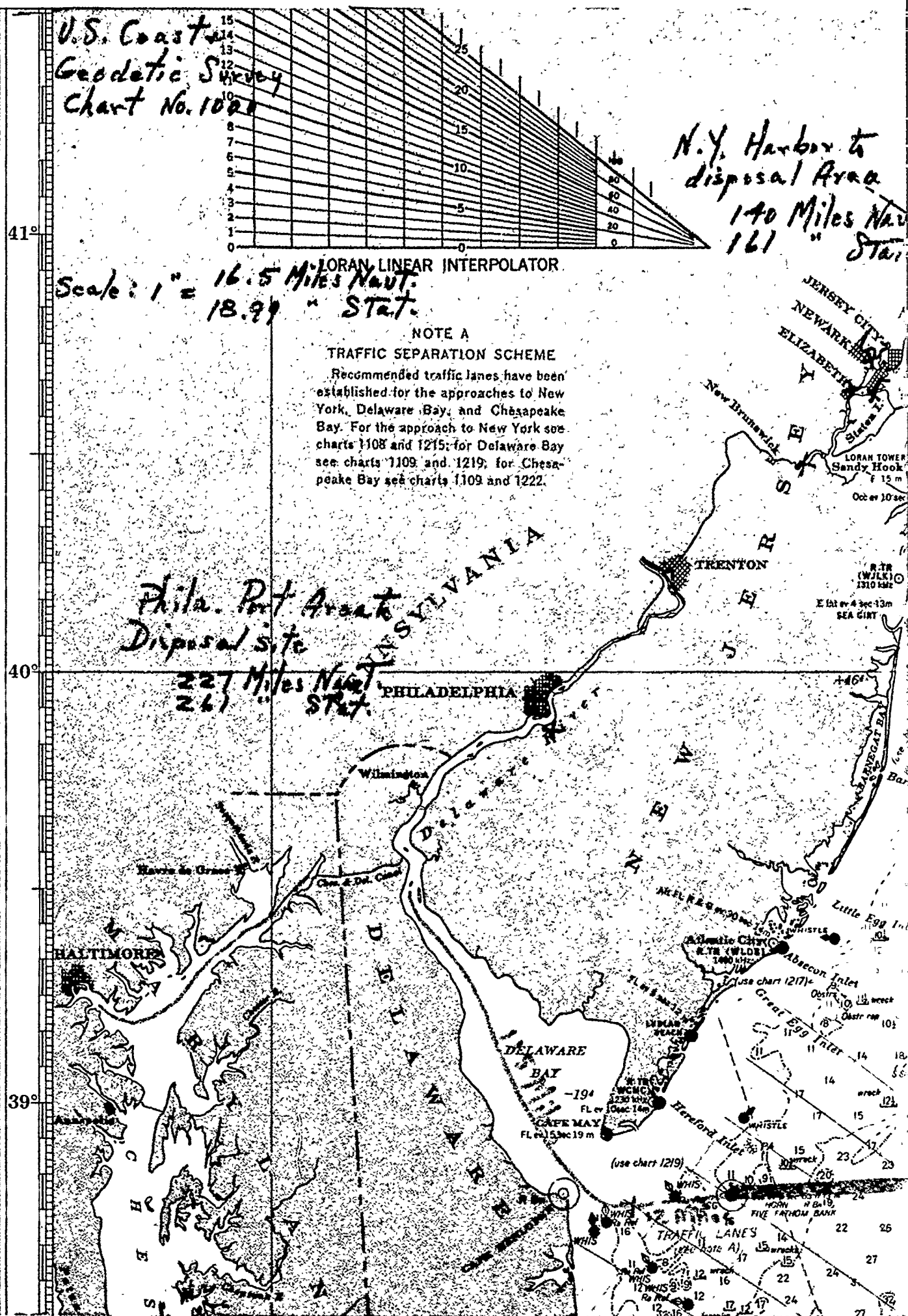
NOTE A

TRAFFIC SEPARATION SCHEME

Recommended traffic lanes have been established for the approaches to New York, Delaware Bay, and Chesapeake Bay. For the approach to New York see charts 1108 and 1215; for Delaware Bay see charts 1109 and 1219; for Chesapeake Bay see charts 1109 and 1222.

Phila. Port Area
Disposal site

227 Miles Naut.
261 " Stat.



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Chapter 6

*Recommended Research and
Investigation for Effective
Coastal Wastes Management*

Effective rational management of the growing volume and variety of wastes generated by our accelerating coastal urbanization requires immediate initiation of a coordinated, long-term national program of research and investigation involving government, industry, and universities. When such a program has begun to supply answers to the many questions raised in the preceding chapters, we can begin to expand effectively our present waste treatment facilities commensurate with the task of maintaining and even enhancing the quality of our coastal waters.

Toward this end, we present here our recommendations for action as developed at the National Academy of Sciences-National Academy of Engineering Coastal Wastes Management Study Session. They are organized to reflect our assessment of the areas in which effective management of society's wastes is limited by lack of knowledge.

Our recommendations do not comprise an exhaustive catalog of information deficiencies in coastal marine science and engineering. Rather, they represent our assessment of a reasonable first step among the many programs of basic long-term research, the design-related investigations, and the collection of specific laboratory and field data, needed for improved design, management, and evaluation of coastal wastes treatment systems.

Our nation enters the present era of awakened and increasing public concern for effective wastes management with an existing and substan-

tial framework of facilities, knowledge, organizations, and competent personnel in the area of coastal wastes management. This framework constitutes a formidable resource for maintaining and enhancing the quality of the environment, and provides a basis for the evolution of expanded and more effective mechanisms for applying scientific and engineering expertise to the problems in wastes management.

GENERAL RECOMMENDATIONS

Concept and Criteria for Waste Treatment

One of the greatest contributions that scientists, especially biologists, can make to conserving marine values is to furnish quantitative guidelines to assist the engineers who have responsibility for designing waste-treatment and disposal systems. The design of such systems must become much more scientifically oriented than in the past. Historically such design has been concerned primarily with maintaining aerobic conditions in the receiving waters and in keeping these waters safe for human health. *This criterion is no longer sufficient.* Methods are becoming available for assessing a broad range of marine receiving-water values. Thus the engineer's design should become less based on the use of "standard" systems and instead be tailored to preserve and enhance the specific receiving-water values of concern.

Professional Development and Institutional Arrangements

In response to the increasing emphasis on preserving and enhancing the quality of receiving waters, it is essential that the existing organizations and scientific and engineering expertise in coastal wastes management be used as a basis for the evolution of new and improved organizations and professional competence. Particular attention should be given to initiating or improving:

1. Coordination of scientific research and engineering investigation, with emphasis on dissemination of the information generated.
2. Planning for multiple use, including preservation, of the coastal waters and estuaries. Special attention should be given to the strength of local initiative in planning and operation within criteria reflecting local, regional, and national interests.

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3. Development of regional policies, goals, criteria, and review procedures concerning resource development and use, including management of wastes, as they affect the coastal zone.

4. Allocation of a fraction of the cost of new wastes treatment systems and facilities to a program of monitoring waste discharges and receiving waters related to the facilities,

5. The quantity and quality of graduate education combining the interests of oceanography, ecology, and engineering.

6. Designation of research preserves to facilitate experimentation in estuaries and coastal waters in which the intrusion of other human influences is minimized.

7. International mechanisms for controlling persistent toxicants, such as chlorinated hydrocarbons, on both a worldwide and regional scale.

RECOMMENDATIONS CONCERNING MONITORING OF WASTE DISCHARGES AND RECEIVING WATERS

Research in Support of a Monitoring Program

Implementation of an effective monitoring program requires the initiation of specific research projects to improve the monitoring capability. Recommended research and development projects include:

1. Develop uniform sampling procedures for mass emission rates and receiving water, with consideration of the requirement for data processing.

2. Develop methods for quantitation of floatable matter and films and for identifying their origin.

3. Review the methods for detection of persistent pesticides.

4. Develop a method for quantitation and classification of persistent organics.

5. Develop a method for quantitation of gross heavy metals and gross acute toxicity.

6. Develop methods for monitoring biostimulants and for interpreting and applying the data.

7. Develop a method for quantitative description of biomass.

8. Develop methods for monitoring long-term effects in a community structure and its productivity.

9. Develop methods of monitoring trace metals (sediments).
10. Develop a method for quantitation of specific organics, especially in trace concentrations.
11. Identify the criteria necessary to define properly the wastes discharges that should be included in the category "significant" waste discharge.

A Monitoring Program

1. A program to monitor waste discharges and receiving waters should be initiated.
2. Characterization of wastes and receiving waters should take cognizance of the need for rapid, accurate, and economical methods for measurement of the selected parameters. In addition, instrumentation should be adapted or developed to perform the analyses and to transmit or record the observed data. Data analysis techniques should be developed so that corrective action can be initiated promptly.
3. Monitoring specifications must be examined periodically to insure their continuing adequacy and to remove redundancy.

Monitoring Waste Discharges

1. To implement a program of monitoring waste discharges, specifications should be developed for a core minimum program to be applied to all "significant" waste discharges. "Significant" waste discharges are to be defined as a result of a research project recommended above.*
2. The general objective of the core, waste-discharge monitoring program is to provide the minimum information needed to assess adequately the pollutorial contribution of waste materials to the Nation's coastal environment. Specific objectives would include but not necessarily be limited to the following:
 - a. Provide quantitative information on the unit and total mass emission rates for the common significant groups of wastes from significant waste-generating activities such as municipal, industrial, agricultural, natural, and other sources so that:
 - (1) Adequate data are available for forecasting future waste contributions, based upon the level of future estimated waste-generating activity (population, industrial production, etc.);
 - (2) Accurate input data are available for use in various model-

*The term "significant" is discussed in Chapter 2.

ing systems to provide estimates of waste concentrations and their variation in space and time; and

(3) It is possible to correlate or develop functional relationships between waste emission rates and waste effects that are principally biological in character.

b. Assess performance, on a gross basis, of waste treatment installations.

c. Insure that adequate information is available to permit improvements in waste treatment and disposal system design and operation.

3. All samples (except for "grab" samples collected for special analyses for high decay rate constituents) collected for routine analysis should be near-continuous, proportional, composite samples which accurately represent the characteristics of the waste stream (i.e., floatable, suspended, and dissolved constituents) with respect to their true mass emission rates (i.e., lb/day). Sufficient samples should be collected to provide an adequate statistical description for both the constituent concentration and the mass emission rate of the contaminant. After the waste has been statistically defined, analyses not pertinent to the local problem or to the wastes characterization should be deleted.

4. The analyses indicated in Table 10 should be conducted on essentially all samples collected.

5. Information on the accuracy and precision of both the sampling and analytical methods should be obtained and reported.

6. Data should be obtained on the level of waste-generating activity (i.e., for municipal waste—population tributary; for industrial wastes—tons of each product/day; etc.) so that waste discharges can be reported on a unit mass emission rate basis.

TABLE 10 Recommended Core Program Analyses—Waste Discharges

Floatable matter	Method needs development
Total and organic suspended solid	Methods adequate
Acute toxicity	Method needs review
Persistent pesticides	Method needs review
Persistent organic compounds	Method needs development
Biostimulants	Method needs development
Gross heavy metals	Method needs development
Coliforms (or equivalent)	Method under continuous review
Radioactivity	Methods adequate

Monitoring Receiving Water

1. For implementation of an effective program of monitoring receiving waters, the objectives of the program should include:

a. Provide intermittent or continuous characterization of the receiving body of water and its terrestrial and atmospheric interfaces. Measurements sufficient to define the significant nature of the water body throughout a time period should be specified on the basis of statistical validity.

b. Provide a knowledge of all sources of mass movement into and residence time within the receiving-water body, establish the significant character of such sources, and evaluate the relative contribution of each to the nature of the water body.

c. Provide for rapid data evaluation and indicate the response procedures appropriate for the given water condition.

2. Monitoring program data should be obtained with consideration of the following factors:

a. Sampling procedures which provide samples representative of the condition of the air, land, and water interfaces at any time.

b. Sufficient vertical and horizontal control points, so that the samples will adequately describe the system.

c. Sufficient frequency of sample collection to validate the analyses within any preselected statistical confidence limits.

d. Analytical procedures that are of defined precision in terms of the parameter being measured.

The character of one restricted water body or coastal regime is quite likely different from another; therefore, no detailed recommendation can be made concerning the items b, c, and d above without enumerating the definitive characteristics of each water body. This analysis hopefully will be accomplished by a monitoring program with enough sampling locations and with sufficient frequency to describe the system within reasonable confidence limits.

Table 11 presents a summary listing of the recommended core program analyses of the waters and sediments. It outlines the recommended application of the tests to either restricted waters, the open ocean, or both for assessment of the condition of receiving waters and the effect thereon of the discharge of treated effluents. The core minimum monitoring program is not intended to be applied in its entirety to all marine waters but only to those bodies of water that receive "significant" waste discharges.

TABLE 11 Summary of Recommended Core Monitoring Program Analyses—
Sediments and Water Column of Estuarine Waters

Analyses	Applicable Region	
	Estuarine Water	Open Ocean
SEDIMENTS		
1. Physical		
a. Particle size distribution (methods adequate)	X	X
b. Temperature (methods adequate)	X	X
c. Other observations may also be needed for particle density, in-place density, and thickness of waste deposits to permit an estimate of the volume and mass of waste accumulated (techniques need evaluation)	X	X
2. Biological		
a. Quantitative description of the standing crop of benthic organisms (quantitative technique needs development)	X	X
b. Other tests including an index of bottom respiration may be useful to indicate the amount of readily biodegradable organic matter in the deposit (technique needs development)	X	X
3. Chemical		
a. Concentration of organic matter by concentration of organic carbon or organic nitrogen (technique needs evaluation)	X	X
b. Presence or absence of H_2S (quantitative technique needs evaluation)	X	X
c. pH (technique adequate)	X	X
d. Other measurements should be made for suspected toxicants when appropriate including specific trace metals (technique needs evaluation)	X	X

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TABLE 11 (Continued)

Analyses	Applicable Region	
	Restricted Water	Open Ocean
WATER COLUMN		
1. Physical		
a. Quantification of floatable material and films with analysis for determination of probable origin of material (method requires development)	X	X
b. Water clarity by photometric or other methods (methods adequate)	X	X
c. Temperature—continuous recording with depth or at least three points in vertical column (method adequate)	X	X
2. Biological		
a. Coliform determination (method needs evaluation)	X	X
b. Biostimulatory characteristics (method to be developed)	X	X
c. Assessment of biomass including standing stock and community structure to determine long-term effects of waste discharges (techniques to be developed)	X	X
3. Chemical		
a. Dissolved oxygen (method adequate)	X	
b. Chlorosity (method adequate)	X	X
c. pH (method adequate)	X	X
d. Nitrates (method needs periodic evaluation)	X	
e. Phosphates (method needs periodic evaluation)	X	

RECOMMENDATIONS CONCERNING PHYSICAL PROCESSES AND INTERACTIONS

Initial Dilution and Diffuser Design

1. Present knowledge of buoyant jet diffusion is nearly adequate for design of outfalls (including a multiple port diffuser) to achieve a pre-

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scribed initial jet dilution and submergence below any given thermocline. However, further research is needed in a number of areas. Primarily, there is need for understanding of line sources, and how well multiple-jet diffusers may be represented by line sources. Although current effects on initial plume behavior are not well understood, they are not as critical a factor as density stratification in predicting initial dilutions due to jet mixing.

2. Methods do not exist for predicting the size and shape of the waste fields (of either conventional or heated effluents) that are developed at the end of the initial jet-mixing stage. Closely coupled with this shortcoming is the problem of lateral spreading due to density differences between the field and its environment. Research should be conducted on both of these problems.

3. For barge dumping of sludges in the ocean, research is needed on flows generated by suddenly released sinking sludge in a stratified environment.

4. Control of thermal waste in coastal waters involves the same kind of stratified flow problems as sewage disposal. Inasmuch as large submerged diffusion structures are not yet in use, some problems of large single jets need special study, such as the behavior of a buoyant surface jet injected in a stream perpendicular to the current.

5. Field studies of flow patterns and dilutions over waste outfalls are needed urgently to confirm design predictions and methods. Most of the hydrodynamics of buoyant jet mixing has been confirmed only in laboratory experiments. Similarly, the effects of hydrodynamic forces on the diffuser structures themselves require continuing investigation.

Physical Processes in Estuaries

1. It is necessary to develop a sound physical basis for quantitative predictive models of time and space variations of constituent distributions in estuaries. This project will require further work on theoretical, numerical, and physical models, including determination of the correlation between the models and field studies.

2. Further knowledge is required of the relationship of the mean circulation, tidal currents, and turbulent exchanges to the river inputs, external tides, external density distribution, wind, and the shape and size of the estuary.

3. Little is known of conditions responsible for the change in an estuary from a salt-wedge to a partially mixed estuary, or from a fiord to either a salt-wedge or a partially mixed estuary. These conditions need study, particularly in fiords.

4. In the development of models, both theoretical and numerical models should be stressed, as they include the possibility of the incorporating of biological, chemical, and physical processes at prototype scales.

5. Turbulence processes need investigation, as their dependence on density stratification and mean-velocity shear plays a dominant role in the behavior of estuaries.

Turbulent Flux and Diffusion

1. Detailed observational approaches to the problem of turbulent diffusion are needed. Simultaneous measurements of turbulent fluctuations in velocity, salinity, and other properties, together with environmental factors such as shears in mean velocity and stability of the water column are necessary. Likewise, tracer studies on a scale of 10-100 meters should be carried out under various environmental conditions.

2. There is need to develop predictive models for gross spreading of patches and plumes in the ocean from the combined effects of eddy diffusion (both horizontal and vertical) and shear in the mean velocity field. Item 1 above recommends steps that will provide a basis for this development, and will allow a better interpretation of previously reported values of gross dispersion coefficients.

3. Systematic tracer experiments should be carried out in subsurface waters in order to have more reliable information on the dispersion of patches or plumes. These experiments should include the use of artificial tracers, such as fluorescent dye, and studies of existing waste fields which occur at subsurface depths.

Physical Processes in Coastal Areas

1. For a proper understanding of coastal circulation on all scales, a program of collection of oceanographic and meteorological data is recommended. The observations should be made over a long enough period of time to reveal all periodicities up to and including annual. Although such a program could be carried out by multiship operations, moored arrays of instruments capable of sampling the entire water column would probably be better. Such a program should permit evaluation of wind, river inflow, tide, and internal waves as transport mechanisms.

2. To improve our ability to predict the fate of wastes introduced into estuaries and coastal waters under specific environmental condi-

tions, a study is recommended of the effects of intermediate scale variations in the current pattern on the time-varying concentrations of waste components at various distances from the source, using tracers such as fluorescent dyes as well as waste components from existing outfalls.

3. The large-scale processes which lead to exchange of coastal water with oceanic water should be studied. Development of a fluorometer capable of sampling at all depths, which is an order of magnitude more sensitive than any available at present, is needed so that large-scale dye-tracer experiments can be carried out economically. Alternatively, a more economical tracer might be developed for such work.

Decay of Nonconservative Constituents as Related to Physical Factors

1. A series of controlled field experiments should be conducted to study the nonconservative properties of such constituents of wastewater as enteric bacteria and other toxic substances discharged into coastal and estuarine waters.

2. As soon as reliable detection and enumeration techniques have been developed, these studies should be expanded to include pathogenic viruses.

Interactions between Floatable and Settleable Components of Wastes and Physical Factors

1. Studies should be conducted to ascertain the prevalence, properties, and character of floatables that originate from waste water and sludge (including barged materials) in coastal waters and in estuaries. The substances comprising the various forms of the floatables (particulate matter, films, scum, and foam) should be identified as to primary source.

2. Investigations should be made to determine the means by which the floatables are collected and compressed into slicks or streaks on the water surface, as well as the natural mechanisms available for transporting the materials in the water surface.

3. Studies should be made to ascertain methods of treating or handling the waste waters and sludges that will reduce or eliminate problems of surface pollution.

4. Studies should be conducted to evaluate the movement and dispersion of releases of sludge at sites currently in use, such as in the New York Bight and off southern California. These studies should in-

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clude, but not necessarily be limited to, investigation of the methods of introducing the sludge, i.e., by barge or outfall, and the transport mechanisms, including settling and resuspension, which influence the distribution and spread of the materials.

RECOMMENDATIONS CONCERNING CHEMICAL FACTORS

Chemical Processes Involving Dissolved Inorganic Constituents

1. The concentrations and forms of trace elements believed to be biologically significant in the waters and sediments and their concentrations in organisms in different areas should be determined. Areas that should be examined are near the mouths of large rivers and coastal areas where freshwater inputs come primarily from waste-water discharges. The elements of concern would probably include but not be limited to copper, zinc, cobalt, chromium, arsenic, molybdenum, selenium, mercury, cadmium, and lead.

2. The degree of complexing of trace metals by the organic and inorganic constituents of waste-water effluents, sea water, and estuarine waters should be evaluated in both laboratory and field studies. Temperature ranges in the natural environment, as well as in the vicinity of thermal outfalls, should be represented in the experimental program. Not only may the degree of complexing prove significant in controlling the behavior of the metal ions, it may also prove pertinent to an understanding of the action of organic residues. The forms in which the metals exist are important factors affecting their biological activity.

Chemistry of Particles and Processes in Sediments

1. Experiments should be carried out to establish the effects on soluble components, particularly waste solutes, of flocculation, aggregation, coprecipitation, and sorption. A study should be made of the physical-chemical factors and the role of organisms in affecting the flocculation rates of sediments in estuaries and coastal waters. Pertinent variables appear to be the degree of dilution of fresh water suspensions entering sea water, the levels of organic matter, the pH of the mixture, the oxidation potential, the relative percentages of different clay minerals and other solid phases, the mixing characteristics of the flow, and the temperature.

2. The rates of aggregation and sedimentation of organic particles in

the marine environment should be studied. Such factors as pH, temperature, organic-metal ion complexing at organic particle surfaces, and the concentration of inorganic particles should be evaluated. Organic debris appears to play a role in transporting trace metals to the sediments. The organic debris may associate with inorganic particles, thus affecting the sedimentation of inorganic phases (oxides, clays, silica).

3. The biological and chemical transformations occurring in contaminated and uncontaminated sediments should be determined, with particular reference to nutrients and trace elements. These studies should include considerations of concentration gradients, movement of water at the sediment interface, eddy diffusion, and the release of gas on the rates of transport from sediments to the water column. Also included should be the effects of changes from oxidizing to reducing conditions, and vice versa.

4. Adequate procedures should be developed for distinguishing among inorganic particles, living organisms, and dead organic matter, both in the water column and in the sediments.

Nutrient Chemistry and Biochemical Changes

1. The fluxes of nitrogen and phosphorus in all phases of the cycles affecting the marine environment should be explored. The study should not overlook the fluxes due to rooted benthic plants, birds, and humans.

2. An understanding should be developed of the amount and character of dissolved and particulate organic matter in the ocean; its origin, including the contributions from rivers and waste discharges; its spatial distribution; and its biological significance.

3. A study of the factors that control the qualitative and quantitative aspects of phytoplankton blooms in estuarine and coastal waters should be carried out.

4. The effects of adding nutrients (phosphate, nitrate, silicate) and oxidizable carbon on the primary productivity and on the resulting organic load in restricted coastal environments should be determined. The relative effects of the individual nutrients are important considerations. The rates of oxygen exchange between the atmosphere and other sources (e.g., ferric oxide in sediments) and the coastal waters should also be studied. These studies will help provide a basis for predicting to what extent re-aeration can compensate for the oxygen demand caused by the introduction of oxidizable carbon and nutrients from waste outfalls. Factors such as wind stress, depth, pressure head, den-

sity gradient and stability, and surface films such as petroleum should be considered.

5. The biochemical mechanisms for concentrating trace components by the biota, the subsequent effects of this concentration on the organisms involved, and the transport and further concentrating of these trace components as they move up the food chain should be determined.

6. Subtle, sublethal effects of waste products on physiological and biochemical processes—such as enzyme induction or inhibition, ion transfer across membranes, and chemosensitive reception—should be studied. Effects of these kinds may significantly influence the growth, reproduction, development, or survival of marine animals in ways not detected by conventional assay or toxicity tests, or population studies. It is in this area of sublethal effects that ocean disposal of wastes may encounter its most serious problems.

The Chemistry of Specific Wastes

1. Even with the establishment of improved safety criteria and redundant emergency systems, the probability of the occurrence of oil leakage and bilge washings from ships, of catastrophic events such as shipwrecks, and of oil seepage and operating well casualties on the continental shelf, indicates that research is needed on:

a. Natural biochemical processes responsible for degradation of oil films or oil droplets.

b. Techniques of analysis for detecting and characterizing low concentrations of oil in water and for identifying sources.

c. The effects of different oil dispersants in degradation of the oil, the toxicity of dispersant and dispersant-oil mixtures to marine organisms, and the uptake of the oil, dispersant, and/or dispersant-oil mixtures in the food chain.

d. The effects of added settling agents on bottom characteristics and on the benthos, and the fate of oil so deposited.

e. Fractionation of oil films on exposure to environmental influences, and the fate of residual materials in the sea.

f. The effect of oil films on the air-sea oxygen exchange, and interference in processes of biological productivity, such as changes in light penetration and mixing.

2. The fluxes of synthetic organic chemicals into the ocean through sewage outfalls, rivers, atmosphere, and biota should be determined. Priorities should be given to potentially hazardous or deleterious materials such as pesticides, detergents, fuel residues, certain solvents, etc.

Chemical Consequences of Man's Physical Activities

1. The effects of human activities (such as forestry, agriculture, terrestrial and marine mining, dredging, and impoundments), on the flow of inorganic suspended matter to the oceans, and on the distribution and character of the sediments should be determined. Among the potentially significant effects are those on transparency of overlying waters, oxygen demand from reducing sediments, transport or release of nutrients including trace elements, alterations of the benthos, silting of harbors, and erosion of beaches.

RECOMMENDATIONS CONCERNING BIOLOGICAL EFFECTS

1. Studies should be made immediately of selected existing outfalls and disposal areas in several distinct marine biogeographic provinces. These studies, and the relationships derived from them, must serve as an interim basis for improved evaluation of the acceptability of new disposal facilities and sites. Completely adequate techniques are not available for definitive assessment of all impacts of wastes on coastal waters. The studies should include at least the following:

a. Quantitative floral and faunal surveys in the immediate vicinity of discharge, within the measurable zones of influence, and at reference sites.

b. Sludge fields (when present).

(1) Measurement of the temporal and spatial dimensions of sludge fields.

(2) Chemical analyses of sample sludges from various outfalls with emphasis on substances likely to have biological importance.

(3) Measurement of the rates of biodegradation and utilization of sludge components by marine organisms.

c. Determination of the dissolved inorganic and organic substances resulting from coastal discharges and their effects by:

(1) A chemical inventory of components.

(2) Bioassays of both effluents and affected waters for toxicity and stimulation.

(3) A study of primary productivity and other community responses in affected waters.

2. A detailed examination of the public health significance of coastal discharges should be made, including:

a. Re-evaluation of the adequacy of traditional fresh-water biological indexes in marine waters and in organisms consumed by man.

b. Development and application of improved indexes.

3. Research on the biological concentration of waste components by marine organisms should be expanded and intensified. Special attention must be given to organisms involved either directly or indirectly in the food chain of man, without sacrificing adequate attention to the complete environment.

4. The input of DDT into the marine environment by the United States should be eliminated. To avoid repetition of the DDT type of problem, we further recommend that any material that combines the properties of mobility, chemical stability, low solubility in water, and high solubility in lipids be kept out of the marine environment unless it has been proven not to have the broad biological activity that is characteristic of DDT.

5. Long-range, properly designed, detailed, quantitative studies of the structure and dynamics of animal and plant communities and their relationship to waste disposal in carefully selected areas should be established and supported. These areas should include those that are relatively little affected, that are being affected at an increasing rate, and that are already seriously affected. Some of the studies should be done in designated and protected marine preserves. All should be related to the beneficial uses to which the particular coastal region is allocated.

6. Programs of physiological studies to define the tolerable limits of waste concentration for each of the specific uses envisioned for the coastal regions designated in a long-range plan should be established and supported.

7. Programs of systems analysis and model development that will improve prediction of the biological effects of various possible combinations of waste treatments, disposal systems, and uses of the receiving water should be instituted and supported. As more data become available from the studies suggested above, models can be continually refined.

8. All proposals for new installations, modifications, or activities that may result in major changes in the amounts or nature of the wastes should be reviewed to determine whether quantitative ecological studies of the biota are required, both before and after the change. If such studies would lead to greater protection of the biota, or would provide better bases for regulation, adequate funds for them should be included in the budget. Enough time must be allowed for careful studies, especially those to be done before the change is made. Data

from such studies would increase the accuracy of models and strengthen the objective bases for setting standards.

9. The U.S. Government should consider, and act effectively upon, the ultimate disposal problems and the biological effects of new products of any kind which, after release in the commercial market, could result in the impairment of the biological values of the marine environment.

Chapter 7

Suggested Priorities and Estimated Minimum Effort Required

Our recommendations select, from among the broad scope of scientific and engineering research and investigation program areas in wastes management, those projects that we believe are essential and that should be assigned high priority to improve effectively our wastes management practices.

We have assigned relative priorities to each of the recommended projects within each of the major program areas. The minimum effort required for effective results and the period required for completion of specific projects has been estimated for each project. *These suggested priorities and allocations of effort are, of course, highly subjective.*

Although priorities were estimated within each of the major program areas, no attempt was made to compare priorities in each of the areas with those in the others. On the other hand, the minimum effort that is suggested for each of the program areas compared with the others indicates our estimate of the relative emphasis to be placed in each area of the total initial minimum program.

Further detailed refinement of priorities should be undertaken on a continuing basis by those within industry, government, and universities who, because of their responsibilities and competence in developing and utilizing the results of the research and investigation, will be involved in operational and research problems. Continued refinement of the estimates of effort required beyond the suggested initial minimum

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effort, and the refinement of time required for the initial and any additional effort, should also be undertaken.

PROGRAM AREA OF MONITORING WASTE DISCHARGES AND RECEIVING WATERS

The recommended routine-type monitoring program should be initiated immediately, should be expanded to meet management information requirements, and should be improved as monitoring techniques resulting from the recommended specific research projects become available. The monitoring program should be a continuing and a regular part of the waste disposal operation. No estimate of required effort for the actual field-scale monitoring program is given.

Table 12 lists the relative priorities and estimated minimum effort for specific research projects that will be required to implement the broad recommendations for a program of monitoring and investigation of waste discharges and receiving waters.

For waste streams like those in agricultural and industrial areas, additional research and development on specific sampling and-analytical methods is required. For receiving-water monitoring, there also will be special development efforts associated with particular monitoring problems. The magnitude of this research and development may be equal to, or greater than, that required for the core monitoring programs recommended in this study.

PROGRAM AREA OF PHYSICAL PROCESSES AND INTERACTIONS

Relative priorities and estimated minimum effort for the recommended research and investigation in physical processes and interactions are presented in Table 13. The relative priorities for each project have been estimated within each of six sets of related projects. The estimates of effort represent that which we believe is required to conduct the recommended programs at a level that will provide beneficial results.

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PROGRAM AREA OF CHEMICAL FACTORS

Relative priorities and estimated minimum effort for recommended research and investigation in chemical factors are summarized in Table 14.

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TABLE 12. Priorities and Estimated Initial Minimum Effort for Research and Investigation Needed for Improving Waste Discharge and Receiving-Water Monitoring Programs^a

Research Required To Implement the Monitoring Program	Research Concerned with		Estimated Minimum Total Effort ^b (man-years)	Priority	Completion Time
	Waste Discharge	Receiving Waters			
Uniform sampling procedures					
Relative to mass emission rates, receiving waters, data processing	X	X	11	A	S ^c
Floatable matter					
Method of quantitation	X	X	11	A	S
Films					
Method of quantitation		X	11	A	S
Persistent pesticides					
Review method of determination	X	X	11	B	S
Persistent organics					
Method of determination, quantitation	X	X	13	B	S
Trace heavy metals					
Method of quantitation	X		7	B	S
Trace acute toxicity					
Method of quantitation	X		7	A	S
Bioassays					
Methods and interpretation	X		34	A	L ^d
Biomass ^e					
Method and quantitative description	X	X	27	A	L
Community structure — productivity ^f					
Methods for long-term effects		X	50	B	L
Trace metals (sediments) ^g					
Method ^h		X	11	C	S
Specific organics ⁱ					
Method of quantitation — trace concentration	X	X	13	C	S
Significant discharge					
Definition of	X	X	4	A	S

^aThe recommended Monitoring Program itself is not included.^bTotal effort for this program area is 210 man-years.^cS is short-term (less than 5 years).^dL is long-term (less than 10 years).^eThese projects must be examined in detail for compatibility with projects recommended under chemical factors and biological effects.

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TABLE 13 Priorities and Estimated Initial Minimum Effort for Research and Investigation in Physical Processes and Interactions

Recommended Research and Investigation	Estimated Minimum Total Effort ^a (man-years)	Priority	Completion Time
Initial dilution and diffuser design	37		
Buoyant jet diffusion		B	S ^b
Waste fields		B	S
Barge dumping of sludge		A	S
Thermal waste		B	S
Flow patterns		A	L ^c
Physical processes in estuaries	185		
Quantitative predictive models		A	L
Hydrodynamics		B	L
Estuary transitions		A	S
Biological and chemical processes		A	L
Turbulence processes		A	S
Turbulent (eddy) flux studies	72		
Observational studies		A	S
Predictive models		A	S
Subsurface tracer experiments		B	S
Physical processes in coastal areas	360		
Data collection		A	L
Intermediate-scale current patterns		A	S
Large-scale exchange processes		B	S
Decay of nonconservative constituents as related to physical factors	20	A	S
Interactions between floatable and settleable components of wastes and physical factors	46		
Character of floatables		A	S
Mechanisms of transport		B	S
Reduction of surface concentration		B	S
Case studies		A	L

^aTotal effort for this program area is 720 man-years.

^bS is short term (less than 5 years).

^cL is long term (less than 10 years).

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TABLE 14 Priorities and Estimated Initial Minimum Effort for Research and Investigation Needed in Chemical Factors

Recommended Areas of Research and Investigation	Estimated Minimum Total Effort ^a (man-years)	Priority	Completion Time
Trace metals	50	A	S ^b
Complexing	22	B	S
Inorganic aggregation	22	B	S
Organic aggregation	17	B	S
Diagenesis	13	B	L ^c
Distinguish organic vs. inorganic	5	C	S
Nutrient fluxes	22	C	S
Organic matter distribution	13	B	L
Phytoplankton blooms	42	A	S
Anoxic conditions	17	B	S
Biochemical concentration	17	B	L
Sublethal effects	34	A	L
Oil spillage	134	A	S
Synthetic organics	17	A	L
Human physical activities	25	C	L

^aTotal effort for this program area is 450 man-years.^bS is short term (less than 5 years).^cL is long term (less than 10 years).

These recommendations, listed as specific projects, are indicative of broad areas of investigation, within which re-emphasis may be desirable in the future.

PROGRAM AREA OF BIOLOGICAL EFFECTS

Priorities and estimated minimum effort for project areas of research and investigation on biological effects are summarized in Table 15.

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TABLE 15 Priorities and Estimated Initial Minimum Effort for Research and Investigation in Biological Effects

Recommended Areas of Research and Investigation	Estimated Minimum Total Effort ^a (man-years)	Priority	Completion Time
1. Intensive study of outfall areas and effects	620	A	L ^b
2. Public health significance of wastes	25	B	S ^c
3. Study of biological concentration mechanisms	40	B	S
4. Management of DDT	-	B	S
5. The structure and dynamics of coastal biological communities	370	A	L
6. Defining tolerable limits for each major use	190	A	S
7. Improvement of systems and models	35	B	S
8. Criteria for review of proposals for ecological study requirements	-	A	L
9. Evaluation of new waste products	-	B	L

^aTotal effort for this program area is 1,280 man-years.

^bL is long term (less than 10 years).

^cS is short term (less than 5 years).

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November 1970 .

Marine Pollution Problems and Remedies

by

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should be made to that Journal in using quotations or in
referring to the views of the authors.

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MARINE POLLUTION PROBLEMS AND REMEDIES

by Oscar Schachter*
and Daniel Serwer*

Marine pollution is a global problem in several senses. It affects the health of the oceans in all parts of the world; it affects all countries, both developed and developing; and all countries contribute to some aspects of the problem. Some marine pollution problems are local, but many have international implications. Particularly if the effects of pollution on the living resources of the sea are considered, very few marine pollution problems can be considered matters of exclusively local interest.

It is not only a global problem in extent but a many-sided complex phenomenon with interlocking economic, technological, political and legal aspects. Obviously, no single remedy or solution can be expected. The simple maxim that those who pollute should clean up or pay compensation has only limited utility. Wastes are disposed of in the oceans partly because the costs and risks of putting them elsewhere are greater. In many cases, the blame for damage cannot be assigned. Even where it can be, liability may not be a deterrent. Outright prohibition may be necessary to prevent pollution but that may involve substantial deprivation to legitimate users. It may well be that new structures of authority are required, as the Secretary-General of the United Nations has recommended,^{1/} but the effect-

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ive exercise of authority would still be limited by the inherent complexities of the problems themselves, by the gaps and uncertainties of scientific knowledge and by the hard facts of economics and political interest. Clearly, the difficulties of setting goals and priorities will not be solved at a single stroke. Continuing wise management will be needed.

This management will need information as well as wisdom. We are profoundly ignorant of much that goes on in the marine environment. The oceans are, along with extra-terrestrial space and the interior of the atomic nucleus, one of the frontiers of scientific and technological research. The present ignorance is not limited to isolated details like the number of fish in the sea, though that too is a question which cannot now be answered satisfactorily. We lack knowledge of fundamental aspects of the physical, chemical and biological working of the oceans. It should be no wonder then that events in the sea like the recent explosion in the population of the Crown of Thorns -- a population explosion which has threatened to destroy coral reefs throughout the Pacific Ocean -- are not quickly explained. This ignorance of the oceans and the life in them is one of the reasons why the problem of marine pollution and its effects must be treated with respect and caution.

The need for information about pollution has been recognized in the plans for world-wide monitoring of the oceans -- most notably, the International Global Ocean Station Systems (IGOSS)^{2/}. That plan rests on an impressive technical capability to gather data through automated buoys and transmit the information throughout the world. But technical monitoring

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capability is not in itself sufficient for producing useful knowledge—it needs to be designed and employed for scientific understanding. Yet because of our ignorance of the oceans, we may not have reached the point where our scientific knowledge of ocean problems would justify a data-gathering system on a global scale.^{3/} Whether or not this is the case, it is quite clear that routine global monitoring will not in itself provide the information required for pollution control. Ocean research, and especially experimentation, are equally required and beyond that a much greater theoretical understanding of the ocean systems and how they work.^{4/} Moreover, for adequate fact-finding a variety of investigators will still be needed, even though there may be several thousand automated buoys dispersed in the oceans. We may recall that the harmful effects of DDT were discovered by the efforts of a multitude of bird watchers, game wardens, conservationists and a variety of professional scientists.^{5/} It is unlikely that a single global automated monitoring system can take the place of that kind of information-gathering network.

What measures can and should be taken in marine pollution control is complicated by the variety of pollutants. These vary not only in their chemical composition and behaviour, but also in the manner in which they enter the marine environment and the nature and extent of their effects. Some materials which pollute the marine environment are discharged intentionally; others are only discharged accidentally. Some sources of marine pollution can be pin-pointed; others are for all practical purposes untraceable. Some marine pollutants maintain their chemical integrity for decades and even centuries; others are degraded to harmless

materials in a matter of hours or days. Some marine pollutants present a clear and immediate threat to marine life; others may only be dangerous in the long-term, and the precise nature of these dangers may still be unknown. No single measure or type of measure, on either the national or international level, is adequate to meet the range of marine pollution problems. Marine pollution control measures must be tailored carefully to fit particular problems. Moreover, the fashioning of these measures is not a task for the imagination alone. The present international system, based as it is on the interdependency of sovereign states, is the material from which solutions must be cut. This system has both considerable capacity and serious limitations for dealing with marine pollution problems.

The capacities can be illustrated most clearly if the specifics of marine pollution problems are immediately at hand. Accordingly, in what follows we select what appear to be the most important marine pollution problems and to summarize what is known about where the pollutants originate, the extent to which they are found in the marine environment, how they affect the marine environment, what international controls now apply and the prospects for future pollution and its control. This is done under four headings: oil, chlorinated hydrocarbons, wastes discharged from coasts and wastes dumped from vessels. This discussion of specific marine pollution problems and remedies is prefaced by a few background facts about the marine environment which bear on the problem of marine pollution.

Some basic facts about the marine environment

While the primary chemical constituent of the oceans is water, many other chemicals are found dissolved in this water. Even in "natural" sea

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water, these chemicals include many of the substances which we refer to as pollutants. Mercury, lead, hydrocarbons similar to those found in oil, and some radioactive nuclides would all have been found in the oceans millions of years ago. The difference between now and millions of years ago is that man is adding to the concentrations of these materials, as well as introducing new materials like chlorinated hydrocarbons, in amounts which are significantly altering the chemical composition of the marine environment. In a number of cases, the "significant amounts" added by man's activities are doubling the natural concentration of marine chemicals and introducing new chemicals in concentrations approaching those of naturally occurring chemicals.

The significance of these added chemicals in the marine environment lies in their effects on the ecology of the marine environment, that is in their effects on the relationship among living things and between living things and their environment. ^{6/} These relationships are delicately balanced. Marine life is interconnected in a web of inter-related food chains, all of which depend in the end on the chemical situation in the marine environment. Diversity of species is an essential characteristic of these food webs, for diversity is frequently associated with stability in ecological systems. At the base of marine food webs there is usually some form of phytoplankton, tiny plants which float on the surface of the sea. Phytoplankton are responsible for the primary production of 90 per cent of the living material in the sea. Moreover, they have produced by photosynthesis about 70 per cent of the oxygen on the earth. The marine life which supplies man with food, usually fish ten inches or longer, are found relatively high in the

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marine food webs. The continued production of these fish depends on the maintenance of the species below them. Of course, changes in food webs have always occurred, with some species becoming extinct and others evolving. The adaptive capacity of marine life may not, however, be unlimited, and the adaptations are not necessarily beneficial to man. The greatest long-term danger from marine pollution lies in its potential for upsetting the ecological balance of the oceans in such a way that man will find the usefulness of the marine environment vastly diminished. That this can in fact happen is clearly demonstrated in many of the world's fresh water areas.

The ecological balance of the oceans can be upset in many ways. Some pollutants simply poison the animals and plants with which they come into contact. Other pollutants make such a demand on the oxygen dissolved in sea water--oxygen which is essential to the life of marine animals--that the living competitors suffocate. Some pollutants encourage the growth of a single species which either consumes or poisons other species. Still other pollutants accumulate in marine food chains and webs because they are not readily metabolized. Pollutants concentrated by food chains can reach levels which upset physiological functions. Examples of these mechanisms can be found in the outlines of the effects of specific pollutants given later in this paper.

The operation of these mechanisms and the effects they have are determined, in part, by where in the marine environment pollution occurs. The oceans are not homogenous. Physical parameters like temperature and pressure vary greatly. Marine life and the nutrients required to support it are not evenly distributed over the oceans, but are instead found

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concentrated in certain areas. These fertile areas of the oceans often lie along coastlines; estuaries are the most fertile areas. Some species of marine life are found concentrated in certain areas, while others range over wide expanses of the oceans. Even the motion of water in the oceans is not uniform. As much as waves may appear to be similar all over the earth, oceanographers find that some water moves rapidly in ocean currents and some water remains in much the same place for many years. Putting a pollutant in some ocean areas is like putting it in a lagoon: it stagnates for a long time. On the other hand, pollutants do not have to be put in a particular part of the oceans, or even in the oceans at all, in order to end up there. Not only do the rivers run into the sea and the currents of the sea run over the earth, but the atmosphere and the sea constantly exchange materials.

Oil

Hydrocarbons in the marine environment come from a variety of sources. These include natural submarine seepage,^{7/} natural decay of marine plant and animal life, shore-based industrial and transport activities, off-shore drilling, wrecked oil tankers and other ships, and discharges from ships which pump out cargo and ballast tanks with sea water. Of the two natural sources, submarine seeps may be controllable, but plant and animal decay is not. Most of the hydrocarbon due to human activities is crude oil, but fuel oil has also been spilled. Fuel oil is usually much more toxic than crude oil.

Of the persistent pollutants in the marine environment, oil is found in the greatest quantities. A recent estimate^{8/} puts oil pollution from

oil transport activities alone at one million metric tons per year and the total from all human activities at no less than ten times this amount.

Another recent estimate puts the volume of oil discharged from sea-going sources, including off-shore wells, at 1.5 million tons per year and the volume of oil from land-based sources at no less than 3 million tons per year.^{2/} If these estimates are correct, the total amount of oil entering the marine environment from human activities is approximately as great as the total amount of hydrocarbon entering the marine environment from natural plant and animal decay. These losses of oil from human activities are not uniformly distributed in the world's oceans. A large fraction of the total oil pollution originates from shore installations and off-shore wells. Much of the oil pollution from ships is spilled in coastal areas, particularly in harbors. The major sea lanes for oil transport at present--the Persian Gulf, the Mediterranean, the western coastal waters of Europe and the eastern coastal waters of the United States--all lie close to coastal areas.

Due to the research efforts of recent years, an outline of what happens to crude oil once it enters the marine environment is now clear.^{10/} The oil first forms slicks whose composition varies from virtually pure oil to a water-in-oil emulsion to an oil-in-water emulsion. Some lighter fractions of oil, including the toxic aromatic hydrocarbons, evaporate quickly if they are exposed to the atmosphere. The slicks float on the ocean surface, spreading and traveling in a way determined primarily by winds and ocean currents. If the oil becomes adsorbed on solid particles--which happens more often in coastal areas--it may sink. Little is known

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about how far the oil sinks and what happens to it deep below the surface or on the bottom. Oil on the surface undergoes auto-oxidation, a process catalyzed by the mineral salts in sea water and by sunlight, and bacterial oxidation. Bacterial oxidation is favoured by dilution of the oil in water and by heat. Below 10 degrees centigrade, bacterial oxidation is very slow, and oil spilled in Arctic areas may last as long as fifty years. Even in temperate zones in the summer, as much as 50 per cent of the oil may remain unoxidized after a week. In coastal areas, oil may be beached, and oxidation continues on the beach. If the oil remains on the sea, tarry lumps are formed. Tarry lumps have been found in the Mediterranean consisting of oil which had been at sea for as long as two months. On a cruise of a Woods Hole research vessel between Rhodes and the Azores, these tarry lumps were found in at least 75 per cent of the tows made with neuston nets on the surface of the sea.^{11/} In the Sargasso Sea, a region of the North Atlantic known for its masses of floating vegetation which is not crossed by major shipping lanes, a research vessel found as much as three times as much tarry material as Sargasso weed in its neuston nets.^{12/} The Expedition "RA" has reported to IMCO that it sailed through water "visibly polluted" with "tar-like or asphalt-like material" on six out of fifty-two days of its trans-Atlantic voyage.^{13/}

In the short term, oil can cause damage to both marine life and the recreational potential of coastal areas. Damage to marine life varies greatly with the species involved, the type of oil and the length of exposure. Birds are particularly sensitive to oil pollution, and attempts to save them by cleaning have been largely unsuccessful.^{14/} Fish populations

do not appear to be affected by short-term exposures to crude oil spills, although fish taken from water polluted with crude oil may be unpalatable. Fuel oil, on the other hand, can kill fish in great numbers. Recovery of a coastal area from the effects of a fuel oil spill can be very slow. Chronic oil pollution, a condition present in some ports, appears to have more drastic effects on marine life than isolated oil spills, primarily due to deoxygenation of the water. Damage to beaches from oil spills appears to be temporary, but it may not be limited to the inter-tidal zone.^{15/} Without special efforts to remove the oil, oil on beaches can last for months, that is for long enough to have a serious effect on areas which depend on beaches for their livelihood.

The long-term, low-level effects of oil pollution are still not well understood. These effects are probably non-lethal to marine life, though some chemicals present in crude oil may be carcinogens. The non-lethal long-term effects may, however, pose serious problems. Even if hydrocarbons present in oil do not kill marine life, they may accumulate in food chains and affect human beings who eat fish. There have been complaints in several countries about fish which taste like crude oil.^{16/} It has been suggested^{17/} that hydrocarbons present in crude oil may interfere with biological processes which depend on low concentrations of chemical messengers—many of which are hydrocarbons—in sea water. The oxidation of oil by bacteria, though it may provide an increase in nutrients available to the food web, depletes the dissolved oxygen supply on which much marine life depends. Under average conditions, the complete oxidation of one liter of oil would deplete 400,000 liters of sea water of its

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dissolved oxygen.^{18/} The long-term effects of oil which has sunk to the ocean floor, where the supply of dissolved oxygen is very limited, are still unknown.

Many techniques have been tried for reducing the volume and effects of oil pollution.^{19/} The most effective techniques have, so far, been straightforward, arduous and expensive. They involve, in general, mechanical removal of oil from polluted beaches, from the surface of the sea or from wrecked tankers. Mechanical removal of oil from beaches is labor-intensive and messy, but with enough effort significant amounts of oil can be removed. Skimming oil from the surface of the sea in large quantities is becoming feasible. The Soviet Union reports that it now has available a specially equipped ship which can skim 7 tons of oil per hour from the surface.^{20/}

It is possible to prevent damage from oil by removing it from tankers before it spills. The United States is experimenting with a system of rubber bladders capable of removing large quantities of oil from wrecked tankers.^{21/}

Canada has succeeded in pumping a large quantity of oil from a sunken tanker.^{22/} Bombing wrecks in order to burn the oil and sinking oil with sand or hydrophilic chemicals have reduced the volume of oil which reaches beaches, but the effects of these measures on marine life is still largely unknown. Oil slicks have been contained with booms, but weather conditions can make this procedure difficult. Chemical dispersants have been ~~used~~ on oil both on the sea and after it has been reached, but the discovery that the dispersants are sometimes more toxic to marine life than the oil they disperse has shed doubt on the wisdom of using dispersants extensively. In addition, oil which is dispersed may still be dangerous to marine life.

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In the future, oil pollution of the marine environment can be expected to increase unless steps are taken to cope with both the increasing volume of oil being produced and transported and the increasing risks of production and transportation. Total world production of oil is expected to increase five times by 1980.^{23/} The percentage of this production coming from off-shore wells is expected to increase as well. Wells are continually being drilled in deeper water, with increasing risks of an accident and increasing difficulties in plugging a blow-out. Many wells are being drilled off the coasts of countries which must import help from abroad when a blow-out occurs. The size of oil tankers used for the transportation of oil is increasing. While many of the new tankers are equipped to retain oily water used for cleaning out tanks on board, the damage which could result from a wreck of one of these tankers is greater than the damage from the Torrey Canyon. The discovery of oil in Alaska and the plans to transport it to the United States through the Northwest Passage have raised the possibility of a major oil spill in the Arctic.^{24/}

A number of legal measures have been taken to deal with the growing threat of oil pollution, and particularly oil pollution from ships, on both the national and international levels. They have been aimed at four objectives: (i) limiting or prohibiting the intentional discharge of oil, (ii) preventing accidents which may cause oil pollution, (iii) eliminating or mitigating oil pollution arising from an accident, and (iv) imposing liability for damage caused by oil pollution. Besides these specific steps, both the 1958 Convention on the Continental Shelf^{25/} and the 1958 Convention on the High Seas^{26/} oblige states to take measures for the prevention of

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damage due to oil in the marine environment.

The limitation or prohibition of the intentional discharge of oil is the object of the 1954 Convention for the Prevention of Pollution of the Sea by Oil, as amended in 1969.^{27/} This Convention prohibits the discharge of oil by ships except under specified conditions and requires special fittings to prevent the escape of oil. It also requires detailed records to be kept and provides for rights of inspection. In the future, any strengthening of this Convention is likely to hinge primarily on the provisions for supervision of compliance rather than on the substance of the prohibition.^{28/}

For the prevention of accidents, the importance of which has been illustrated repeatedly by incidents off many coasts, there is a need for legal requirements concerning the design and equipment of ships, the use of navigation instruments, qualifications of officers and crews and in some cases maximum speeds, traffic lanes and compulsory pilotage. Regulations of this kind have been adopted in many national jurisdictions but they have not yet been prescribed by international conventions. The Intergovernmental Maritime Consultative Organization is planning to hold a conference in 1973 for the preparation of a "suitable international agreement for placing restraints on the contamination of the sea, land and air by ships, vessels or other equipment operating in the marine environment."^{29/} Even apart from international agreements, however, states presumably have the right under general international law to prohibit any ship which does not conform to reasonable standards of design and equipment (or which fails to meet other safety requirements) "from crossing their territorial seas and contiguous zones and from reaching their ports."^{30/} The exercise of this

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right by even a small number of states could have a widespread effect, for many oil tankers depend for their trade on a limited number of major ports.

The elimination or mitigation of oil pollution arising from an accident which has already occurred is the object of the 1969 Brussels Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties.^{31/} This so-called Public Law Convention contains provisions entitling a coastal state facing grave and imminent danger from oil pollution to take necessary measures to prevent damage to its coasts. Although coastal states may be said to have this right already, independently of the Treaty, the new Convention is a step forward in that it spells out the modalities for the exercise of that right and provides for consultation with states and persons who might be affected. It also includes specific provisions for conciliation and arbitration in the event of controversy between States Parties to the Convention.

The imposition of liability for damage caused by oil pollution is the object of the 1969 Convention on Civil Liability for Oil Pollution Damage.^{32/} While providing for strict liability irrespective of fault, the Convention entitles an owner who is not actually at fault to limit that liability to an aggregate sum of 210 million francs (approximately \$14,000,000). The Convention also requires owners to maintain insurance or other financial security, a requirement which may result in improvements in ship design and equipment as a consequence of conditions that are likely to be required for insurance.

These measures for the control of oil pollution from vessels are important, but they would be more effective if the capability of states to

take action were increased. The burden of responsibility for acting to prevent oil pollution rests with states, but not all states are equipped to execute this responsibility. Capping blow-outs, detecting oil spills and identifying their origin, bombing a wrecked tanker in order to set its oil on fire, sinking an oil slick, skimming oil from the surface of the sea and any number of other measures which can, and which under existing and proposed treaties should, be taken by coastal states are all measures which require a considerable degree of technical expertise and extensive financial resources. This is true as well for many of the measures which states can and should require of the vessels operating under their own flags. Few states possess all the expertise they need or could use in this area. It might, indeed, be wasteful if all states did individually possess the capacity to take all possible measures for the control of oil pollution from ships and off-shore wells. Even wealthy countries may find it difficult to mobilize the necessary manpower, technology and hardware. Individual developing countries, many of which have only short coastlines, may find it much more difficult to institute the necessary pollution control measures. There would appear to be considerable potential for international action in helping states to acquire, either singly or cooperatively, the capability of carrying out adequate oil pollution control.

Even with adequate control of oil pollution from ships, however, the problem of oil pollution would not be solved. Shore-based sources of oil pollution account for at least as much oil pollution as the sea-going sources. The point is being reached at which the returns on efforts to control shore-based sources of pollution may be greater than the returns

on efforts to control pollution from ships. Some individual states have taken steps to curb shore-based sources of oil, but there has been no coordinated effort to reduce oil pollution from shore-based sources. In this as in other pollution problems, a state which is conscientious in controlling pollution may be putting its industry at a competitive disadvantage to the industries of states which do not take steps to control pollution. The provision of Article 25 of the 1958 Convention on the High Seas that "All States shall cooperate with the competent international organizations in taking measures for the prevention of pollution of the seas or air space above, resulting from any activities with radio-active materials or other harmful agents" creates an obligation which could apply to shore-based sources of oil, but this depends on international organizations doing their part in initiating the necessary measures. Any such effort would have to recognize that, as in the case of oil pollution from ships, the control of oil pollution from shore-based sources requires a considerable degree of expertise. There are many different technological, administrative and legal tools available for controlling industrial pollution. Sharing experiences with these tools, as well as coordinating the use of them when it is desirable, can help to make them both more effective and more equitable.

Chlorinated hydrocarbons

The term chlorinated hydrocarbons refers to a group of pollutants which are chemically similar but come from different types of human activity. The chlorinated hydrocarbon pesticides—including DDT, dieldrin and aldrin—and the polychlorinated biphenyls (PCB's) are known to be important pollu-

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tants in the marine environment. The pesticides usually enter the environment as sprays for agricultural pest control. PCB's are not intentionally introduced into the environment on a large scale. They are manufactured for a variety of uses, including insulation and fire retardation. How they enter the marine environment is still unknown. Although chlorinated hydrocarbons--and particularly DDT--are used in many parts of the world, much of their production is concentrated in the developed countries. In 1968 approximately 25 per cent of the total world production of DDT was manufactured in the United States. Two-thirds of this DDT was exported.

Chlorinated pesticides enter the marine environment in two ways: in water run-off from agricultural areas and from the atmosphere. The major source of the pesticides in the marine environment is the atmosphere.^{33/} Greater concentrations of pesticides are not necessarily found in areas where the amount of run-off from agricultural areas is greatest. Rather, the global distribution of pesticides appears to be what would be expected if the pesticides were distributed by winds. As much as 50 per cent of the pesticides sprayed in agricultural areas never reaches the plants they are intended to protect. Much of the remaining 50 per cent is carried off by winds into the atmosphere. DDT has been detected on dust particles in areas far from any spraying of pesticides. Precipitation carries pesticides from the atmosphere into the marine environment. DDT and DDT residues have been found in penguins in the Antarctic and in petrels in Bermuda.

Precisely how much chlorinated hydrocarbon is in the marine environment is not known. One estimate^{34/} puts the total amount of DDT--the chlorinated hydrocarbon which has been manufactured in the greatest quanti-

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ties—in the biosphere at one billion pounds. Since DDT is a persistent pollutant—its half-life is probably between ten and fifty years—much of the total amount can be expected to enter the oceans. The total amount of DDT in the marine environment is not, however, an enlightening fact. In terms of the effects of chlorinated hydrocarbons on marine ecology, what counts is the concentrations found in marine life. Concentrations of chlorinated hydrocarbons vary greatly according to where one looks for them. Chlorinated pesticide concentrations large enough to cause wide-spread concern are found in fish and marine birds. PCB concentrations are usually several orders of magnitude smaller. Chlorinated hydrocarbons are not readily metabolized, but dissolve in fat. Even when they are metabolized the products of the metabolic reactions are usually chlorinated hydrocarbons themselves. Because they are not readily metabolized, chlorinated hydrocarbons accumulate in marine life and are concentrated by food webs. Oysters alone have been found to amplify small concentrations of DDT 70,000 times in a month.^{35/}

At their present levels in the marine environment, chlorinated hydrocarbons do not appear to be directly lethal to any species. Serious non-lethal effects are, however, possible. Laboratory experiments have shown that low concentrations of DDT can inhibit photosynthesis in phytoplankton. It has been shown that this effect does not threaten the world's oxygen supplies,^{36/} but because phytoplankton are at the base of many marine food chains, "changes in the rate of primary photosynthesis are certainly critical to man's food resources."^{37/} Field observations and laboratory experiments have shown that DDT is causing reproductive failures in a number of marine

and other birds and possibly in crabs as well. The reproductive failures in birds are often due to thin-shelled eggs, which in turn are due to interference by DDT in the normal sex-hormone metabolism. DDT and other chlorinated hydrocarbons are present in detectable amounts in other forms of marine life, including marine fish. Levels of DDT contamination in marine fish may, in fact, be "approaching levels associated with the collapse of fisheries in freshwater areas." In which case, according to one expert, "we could soon expect a repeat performance in the oceans." ^{38/} Much less is known about the effects of PCB's than about the effects of DDT.

The control of pollution by chlorinated hydrocarbons depends almost entirely on discontinuing their use. Methods of control which apply to many other pollutants--such as degradation, dispersion and collection--are not feasible for persistent pollutants found in low concentrations. Chlorinated hydrocarbons are not readily degraded to harmless materials; they are already dispersed and cannot be collected. The major problems facing control of chlorinated hydrocarbons are to determine what levels are harmful and how their use can be discontinued before concentrations reach these levels. The first is a technical problem with a technical solution. The second is an economic, social, administrative, legal and even a political problem and its solution is likely to be complex. Particularly in the case of the pesticides, prohibition is likely to be expensive and difficult in every way. The chlorinated pesticides are considered essential to maintaining health in countries with insect-borne disease. Several countries, including Hungary, Sweden and Denmark, have prohibited the use of DDT, but none of these has a major problem with insect-borne disease. Even in these

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countries, the banning of DDT may not be an unalloyed benefit. As the recent deaths from parathion,^{39/} an insecticide which has been used instead of DDT in the United States, remind us there is as yet no entirely satisfactory substitute for DDT. Banning DDT and other chlorinated hydrocarbons in individual countries may not have the desired effect, for this may lead to "the economic dumping of large quantities in tropical countries where there are pests enough and little control over the production and use of pesticides."^{40/} The Director-General of the World Health Organization has made it clear that he feels DDT should not be banned world-wide because of its importance in malaria control.^{41/}

In the future, chlorinated hydrocarbons in the marine environment are likely to increase. With the production of many chlorinated hydrocarbons continuing to increase, a major spill of these materials becomes more likely. The example of Rhine fish kill, in which approximately 200 pounds of the pesticide endosulfan killed at least 100 tons of fish, is now a matter of record. Even without such a spill, and even if the use of chlorinated hydrocarbons were discontinued today, one might expect an increase in their concentration in the marine environment due to those already en route to the oceans. Several species of marine birds have already been decimated by reproductive failures due to chlorinated hydrocarbons, and extinction of some of these species appears likely. The loss of several bird species may not seem to outweigh the health benefits of chlorinated pesticides, but the long-term effect of these losses on marine ecology is not yet known. Nor, for that matter, is there any reason to believe that chlorinated hydrocarbons will affect only bird populations. No final accounting can be

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made until all the costs are reported.^{42/} Action for the control of chlorinated hydrocarbons should not, however, have to wait for a final accounting. A number of recent suggestions for general principles governing man's interaction with his environment have recognized the importance of preventing irreversible ecological changes and preserving the diversity of natural systems.^{43/} It is possible that the Universal Declaration on the Human Environment to be presented at the United Nations conference on the Human Environment will incorporate such suggestions. While a final accounting on DDT and other chlorinated hydrocarbons is not yet available, the extinction of bird species due to the effects of DDT and other chlorinated hydrocarbons is an irreversible change.

As already mentioned, Article 25 of the Convention on the High Seas requires States Parties to cooperate with the competent international organizations in taking measures for the prevention of pollution of the seas resulting from any activities with "harmful agents." Since DDT, and perhaps other chlorinated hydrocarbons as well, may be considered a "harmful agent," the States Parties would be obliged to cooperate with the competent international agency in limiting DDT, but thus far no international organization has adopted recommendations restricting the use of DDT or other chlorinated hydrocarbons. Some states have prohibited the use of DDT, but without international action uncoordinated national measures may do no more than change the pattern of use of chlorinated hydrocarbons.

Other countries have banned the production of DDT, at least for some purposes. While banning production may be the most effective way of halting DDT use, it may put an excessive financial strain on developing countries who must then purchase higher-priced substitutes. International measures are needed to coordinate a planned reduction in the use of chlorinated hydrocarbons. Such measures might include regulating trade in chlorinated hydrocarbons, setting standards for their use and providing subsidies to developing countries for the difference in price between DDT and less persistent substitutes.^{44/} Some uses, such as the spraying of crops, might be identified as non-essential and subject to limitation. Other uses, such as the painting of walls with DDT to prevent the spread of malaria, might be considered essential and exempt from limitations.^{45/} Regulating trade and providing subsidies may be facilitated by the concentration of chlorinated hydrocarbon production in developed countries.

In addition, the international community should consider equipping itself to gather the knowledge it needs to take action on questions of this type. At present, the long-term, low-level effects of pollutants in the marine environment are primarily matters for scholarly study and lay speculation. The problem of how technical matters for widespread concern are to be presented reliably for national and international consideration and action remains unsolved, particularly on the international level. Technical problems are, of course, handled by the secretariats of international organizations, committees of scientists and the normal diplomatic apparatus. There is, however, little machinery for direct interaction between those with technical knowledge and those

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with administrative and legal skills. ^{46/}

Wastes discharged from coasts

The term wastes is a broad one covering materials of different chemical compositions from many different sources. Wastes are often divided into two major categories: domestic and industrial wastes. For our purposes, domestic wastes include domestic sewage, wastes from food-processing, detergents, and run-off from agricultural areas. Industrial wastes include heavy metals, radioactive nuclides, inorganic chemicals and heated water. ^{47/} Wastes discharged from coasts enter the marine environment from rivers used for waste disposal, as well as from effluent points located on the coast. The composition of wastes entering the marine environment varies greatly according to the source of the waste and the extent of treatment it receives. Pollution from wastes differs from chlorinated hydrocarbon pollution, and in part from oil pollution as well, insofar as the bulk of the pollution from wastes arises from the intentional discharge of materials into the marine environment. Marine pollution from wastes is generally a less severe problem than fresh water pollution from wastes, but the two issues are not independent of each other. For example, it has been noted that "Indiscriminate discharges have converted many of the rivers of northern England into biological deserts" and that as a result, "the seas into which they flow are in danger of falling into the same state..." ^{48/} Estuarine disposal of wastes can be particularly harmful because as much as two-thirds of the marine animal population depends directly or indirectly on estuarine waters. ^{49/}

The problem of wastes in the marine environment is widespread. In

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a United Nations survey of member countries in 1966,^{50/} forty-three of the forty-nine countries reporting marine pollution problems cited pollution from wastes as a problem. The single most frequently cited marine pollution problem was domestic wastes. The thirty-two countries citing domestic wastes as a problem included both developed and developing countries. Indeed, the problem of domestic wastes depends in large part on population and its distribution, perhaps to a greater extent than any other form of pollution. Agricultural practices also affect the quantity of domestic wastes, with fertilizers and animal wastes making a significant contribution. In the United States, the volume of animal waste has been estimated to be ten times as great as the volume of human waste.^{51/}

Some type of industrial waste was cited as a pollution problem by thirty-eight of the forty-nine countries reporting marine pollution problems in the U. N. survey. The most frequently mentioned industrial wastes were heavy metal compounds, petrochemicals, pulp and paper wastes, oil, and dredging and mining spoils. Although some marine pollution from industrial wastes is accidental and occasional, most is intentional and routine. Industries are often located along rivers, lakes and coasts because of the ease of waste disposal in water. As is the case for domestic wastes, the methods used for disposing of industrial wastes vary from mere dumping of untreated materials to ^{the} discharge of extensively treated effluent, but it is often the case that industrial wastes are more toxic than domestic wastes.

The effects of both domestic and industrial wastes depend on the chemical composition of the wastes, their physical state, the method of

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discharge, the place of discharge, and local environmental conditions. Two of the more important polluting effects of a number of domestic and industrial wastes in the marine environment are over-fertilization and poisoning. Over-fertilization is due to an excessive flow of nutrients into the marine environment. The nutrients can be many different chemicals including the nitrates found in fertilizers and the phosphates found in detergents. Over-fertilization becomes evident when the population of a marine species, often a species of phytoplankton, increases very quickly, causing what is known as a bloom. Blooms occur naturally--that is without the addition of nutrients into the marine environment by man--but they have become much more frequent with the increased disposal of nutrients by man. Blooms of phytoplankton known as the red tide occurred along the Florida Gulf Coast in 1916, not again until 1932, not again until 1948, and then in 1952, 1953, 1954, and every year between 1957 and 1964 inclusive. Other species of phytoplankton have caused different colored tides off the coasts of Ceylon, Brazil and Spain. Irritating smells are often associated with blooms, and some blooms kill other forms of marine life. When a bloom dies, decay of the organic material can cause de-oxygenation of the water. Serious economic damage to coastal recreational areas and to fishing have resulted from outbreaks of red, and other, tides.^{52/}

Blooms of phytoplankton are not the only way in which over-fertilization from domestic and industrial wastes can affect the marine environment. The chemical breakdown of nutrients uses oxygen dissolved in sea water. Since this oxygen is essential to marine life, shortages due to the chemical breakdown of nutrients can decrease the fertility of ocean areas. There are

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indications that such shortages are occurring in the Baltic Sea due in part to phosphorous from human activities. The situation there may be such that "an increase of organic material probably will result in permanent anaerobic conditions."⁵³ In many coastal areas, nutrients have encouraged the growth of bacteria to the point where the waters are unsuitable for bathing. Despite extensive treatment of domestic sewage, the bacterial count in New York Harbor has increased at least ten times between 1948 and 1968, probably due to nitrogen enrichment from land run-off. The invasion and decimation of commercially utilized kelp forests off the California coast by sea urchins was traced to sewage effluent. Sewage effluent probably encouraged the growth of both the kelp and the sea urchins, but the balance tipped in favour of the sea urchins.

The danger of poisoning from domestic and industrial wastes depends in part of the ability of individual species and food webs in the marine environment to concentrate poisonous materials. Although the water from red tides off the Florida coast seems not to be poisonous to human beings, oysters taken from the same water and eaten can cause illness. Mercury which was discharged in small quantities from a factory in Minamata, Japan was diluted in a bay but accumulated in fish.^{54/} Throughout the 1950's and into the 1960's, incidents of mercury poisoning from these fish occurred. If what is known of the pollution of fresh water areas is an indication of what may be happening in the oceans without our knowledge, pollution of the oceans by other poisonous metals may well be discovered soon. Strontium 90, most of which comes from atmospheric nuclear weapons tests conducted over the last twenty-five years, may have accumulated in some fish to levels which contribute to

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high mortality rates.^{55/} Although many scientists feel there is no danger from radioactive wastes in the marine environment, at least one expert feels that the danger from accumulated radioactive wastes is so great that no more marine disposal of such wastes should be permitted.^{56/}

The discharge of wastes from coasts into the marine environment is likely to increase in the future. There are few areas of the world in which waste treatment has been able to keep pace with economic and population growth. Moreover, in many areas industrial expansion and population are both becoming more concentrated in coastal areas. One-third of the population of the United States already lives in the 15 per cent of the U.S. land area which is considered coastal,^{57/} and this coastal concentration of population is increasing. The volume of industrial wastes in the United States--already twice the volume of domestic wastes--is expected to increase seven-fold within a decade.^{58/} Increasing power demands during the next several decades will be met in part by an increase in the number of nuclear-powered generating plants. Although the impact of increased power generation will be felt most strongly in inland waterways, marine areas will also be affected. In 1969, nine nuclear-powered generating plants were scheduled to be built on Long Island Sound by 1975, with water from the Sound used for cooling. Increased concern about environmental problems will not necessarily act to decrease marine pollution from wastes. Concern about the effects of wastes on inland waters and land is increasing the pressure for marine disposal.

The effects of increasing marine disposal of wastes will be determined by the care taken in the management and conservation of the capacity of the

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oceans to absorb and recycle wastes. This capacity is, indeed, an important natural resource. Like other natural resources, it can be squandered. In many cases, no more thought is being given to the increased discharge of wastes into the marine environment than has been given to the discharge of wastes into inland waters. The Baltic, many times the size of the Lake Erie, may be even more contaminated than Lake Erie.^{59/} As mentioned above, one of the major problems in the Baltic is de-oxygenation of the water due to an excess of phosphate nutrients. Meanwhile, some parts of the marine environment, particularly mid-ocean areas, are poor in nutrient and as a result are unable to sustain large populations of marine life. Wise disposal of nutritious wastes in these areas might contribute to an expansion of the world's fish resources. Even if such intentional fertilization of mid-ocean areas is not possible, disposal of wastes farther from shore may be preferable because of the importance of coastal, and particularly estuarine, waters to marine life and to man. Heated water from nuclear-powered generating plants can be harmful to some marine life, but it can also be beneficial to the growth of shellfish. There will, however, be little opportunity to reap this benefit if shellfish producing areas continue to be destroyed by other kinds of pollution. Marine pollution from wastes is not simply a problem of good against evil. A major part of the problem may be how to turn evil into good.

The direct effects of wastes discharged from coasts are usually felt most immediately by the coastal states from which they are discharged, and coastal states possess the authority to deal with this type of marine pollution. Unfortunately, pollution problems arising from wastes have come to be viewed by some as luxury problems on which only the developed countries

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can afford to spend time and money. In the case of wastes discharged from coasts, this point of view overlooks the importance of coastal waters as a natural resource to both developing and developed countries. It is unrealistic to expect that many governments will protect coastal areas from pollution by wastes when these areas are of little or no economic importance, but it is a mistake to assume that coastal areas are in fact of little or no economic importance. With many developing countries depending increasingly on fish for food, off-shore wells for oil and foreign exchange, and beaches for tourism--to mention but a few of the important uses of coastal areas in developing countries--the control of pollution from coastal waste disposal can clearly be viewed in many cases in the context of the development of marine resources. Moreover, coastal waste discharges are one aspect of the total waste disposal problem whose impact on fresh-water areas has long been recognized as a development problem. The international apparatus which exists to promote development has taken some action along these lines. The United Nations Development Programme Special Fund has, in cooperation with the World Health Organization, a number of field projects on waste disposal in coastal areas of developing countries. The World Health Organization, in cooperation with the Food and Agriculture Organization, is offering its first course on coastal pollution control in 1970. Further financial aid and technical assistance in planning and executing both coastal development and coastal pollution control will contribute to both the economic development of marine resources and the solution of waste disposal problems of developing countries.

The wide variety of effects which wastes can cause in the marine

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environment, as well as the many sources and types of waste, makes the control of pollution from wastes a particularly complex task. In many countries, control of wastes in the marine environment depends on cooperation among authorities whose primary missions are diverse (public health, wild-life conservation, fisheries, agriculture) as well as cooperation between local and national authorities. The needed cooperation is often lacking. During the summer of 1970, a Genovese city official who had closed the city's beaches because of pollution from wastes was overturned by a national official who asserted that the coast was so badly polluted that only national authorities had the power to act.^{60/} This incident is admittedly an unusual manifestation of the problems arising from divided authority—it is surely more often than the case that divided authority leads to lack of any action—but it illustrates the frustrations which many officials have experienced. On the international level, authority is not so much divided as non-existent. Officials from France and Italy have traded charges over pollution in the Mediterranean. The French claim they are the victims of wastes from Italy; the Italians claim they suffer pollution from oil slicks originating in the port of Marseilles.^{61/} Handling such problems through the normal diplomatic channels may well be slow and difficult. Direct cooperation on such problems between non-diplomatic officials in different countries may be desirable. Indeed, the reluctance of local officials in some countries to surrender authority to either national officials or international organizations may make such cooperation a necessity.^{62/}

A basis for the international regulation of waste disposal can be found in Article 25 of the Geneva Convention on the High Seas (which has

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been quoted above in the discussion of oil) on the premise that the wastes disposed of may be "harmful agents" if they are high in toxicity or if for other reasons they cause substantially deleterious effects. The obligation placed upon the parties by that Article to cooperate with competent international organizations in taking measures for the prevention of pollution by such harmful agents requires as a condition precedent that an international organization adopt recommendations or regulations for measures.^{63/} This has been done to a limited extent for radioactive wastes by the IAEA^{64/} and for toxic chemicals by the World Health Organization.^{65/} On a more general basis, studies have been undertaken by regional groups^{66/} and by the Joint Group of Experts on the Scientific Aspects of Marine Pollution. The increasing concern with the effects of some wastes on food resources and human health is likely to lead to the adoption of standards at least for some substances and to recommendations on means of disposal.

It is also of course open to individual states to bring an international claim on the basis of general international law if it could show that it has suffered injury within its own territorial sea or if it were damaged in respect of fish stocks which were normally exploited by nationals of that state. Presumably the doctrines of Corfu Channel and Trail Smelter would be relevant but of course there would be serious questions regarding the degree of the harm and the standards of proof required.^{67/} However, it is quite obvious that this is a problem that does not lend itself to adequate treatment through international claims and that what is needed is action by an international organization which will bring into play the existing obligation of Article 25.

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Wastes dumped from vessels

Wastes dumped from vessels are discussed separately here because some of them pose problems which are qualitatively different from the problems which arise from wastes which are discharged from coasts. Two methods of dumping wastes from vessels should be distinguished: wastes which are dispersed and wastes which are containerized. Wastes dispersed from vessels differ from wastes discharged from coasts primarily in that they are more likely to be discharged directly into international waters. Containerized wastes dumped from vessels, in addition to being dumped frequently in international waters, are often highly toxic materials.

According to an ITCO survey,^{68/} the dispersed wastes include dredging spoils, industrial wastes, garbage and trash, large pieces of machinery and sewage sludge. The United States disposed of about 48 million tons of wastes in this way during 1968.^{69/} New York City has been dumping sewage sludge in international waters for twenty-two years, thus creating a "dead sea" at the mouth of its harbor. Researchers who recovered a fish from almost five miles deep in the Puerto Rico trench also recovered "empty paint cans, fruit juice cans, beer can lids, pieces of old aluminum, empty bottles and flashlight batteries"^{70/} from the same depth. The effects of the dispersed wastes are as varied as the effects of wastes discharged from coasts. Some are clearly harmful, poisoning marine life and tearing fishing nets. Others may provide habitats for marine life. The feasibility of creating artificial reefs out of discarded automobiles and automobile tires is being studied.

Wastes are often containerized in the hope that they will remain

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containerized for long periods, with dilution occurring very slowly or not at all. The wastes which are containerized and dumped in the oceans are usually wastes whose dispersion is considered dangerous. These include low-level radioactive wastes and highly toxic chemicals. Many of these chemicals—such as the chemical weapons mustard gas and nerve gas—are wastes only in the sense that someone wants to be rid of them, and not in the sense that they are the unwanted by-products of human activities. Disposal of containerized wastes in the marine environment inside or outside national jurisdictions is often a government-supervised or a government activity.

How much containerized waste has been dumped in the oceans is not known. Registration of dumpings has been recommended and studied several times in the past, but governments have been reluctant to reveal what they dump and where they dump it.^{71/} What is known about the dumping is what it has been going on for some time and continues today. Surprisingly high levels of arsenic in the Baltic Sea led recently to the discovery that 7,000 tons of arsenic had been dumped almost forty years ago in concrete containers, reportedly enough to kill the population of the world three times over if properly administered.^{72/} In recent years, nerve gas has been dumped in the Gulf of Mexico and the Atlantic Ocean by the United States and a number of European countries continue to dump containerized chemical weapons and radioactive wastes in the Atlantic and Mediterranean. In some cases, extensive studies have been undertaken to determine the likelihood of damage. In other cases, it is difficult to know how much care has been taken because the operations were conducted under military secrecy.

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The extent of damage from containerized wastes so far appears to be minor. There is no evidence that there has been damage from containerized radioactive wastes,^{73/} although in at least one instance a container of low-level radioactive wastes dumped in the oceans has been found washed up on shore. Containerized chemical wastes have caused damage in several cases. Danish fishermen operating off the Swedish coast in the Baltic have been burned by fish contaminated with German mustard gas dumped by the Allies after World War II.^{74/} Similar incidents have occurred elsewhere. Recent research indicates that fish and plant life on and near the ocean floor is more extensive than was once thought,^{75/} and any estimate of the potential danger from containerized wastes may have to be increased accordingly. Moreover, ocean currents are still not well understood, particularly at great depths. Prediction of where a container of wastes dumped in the oceans will lie, even immediately after it is dumped, is very difficult.

Perhaps the greatest potential danger from containerized wastes arises from the uncertainty of when and how the material in the container will be dispersed in the marine environment. Containers are usually made of very strong materials, often concrete or steel or both. Concrete, however, does crumble and steel rusts. Earthquakes on the ocean floor can break open any containers known. No one expects the containers to last forever, even those who make them. The usual expectation appears to be that materials will escape from the containers slowly and be diluted in vast quantities of sea water. No one can guarantee that this will indeed happen, and even if it does, that marine life will not be contaminated.

Since little is known about the quantities of containerized wastes

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dumped in the oceans in the past, it is impossible to estimate whether dumpings are likely to increase or decrease. The United States has curtailed dumping containerized radioactive wastes in the oceans, but a number of European countries and perhaps others as well continue to dump considerable quantities of low-level radioactive wastes. With the uses of atomic power and radio-active materials expected to increase rapidly in many countries during the next few decades, and with suitable areas for burial of radioactive wastes on land scarce in many countries, there will be no scarcity of radioactive wastes to dump in the oceans. Containerized chemicals to be dumped in the oceans are also plentiful; marine disposal of out-moded or defective chemical weapons will probably continue.

The inadequacy of the international machinery to deal with marine dumping of containerized wastes has been most clearly demonstrated by the sinking of a ship loaded with nerve gas rockets in the Atlantic Ocean by the United States in August 1970. American citizens, including Florida state officials, were able to file a suit in an American court and at least force what had been planned as a secret military operation into the public arena. It was possible that this suit would stop the proposed dumping. The international machinery was not nearly as fast-moving or effective. The Bahamas, whose citizens probably had at least as much at stake as those of the State of Florida, could only act through normal diplomatic channels. No mechanism was available for the public presentation of technical testimony concerning the nerve gas dumping by interested parties outside the United States or for an independent evaluation of the dumping on the international level. It may be that the dumping will not cause any damage and

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it may be the case the marine disposal was the best of the available alternatives.^{76/} Necessity in this one case does not, however, justify the general lack of mechanisms for reconciling international disagreements and protecting the common interest. The dumping of the nerve gas in international waters was no more a private matter of the United States than it was a private matter of the United States Army.

The problem of wastes dumped from vessels, like the problem of chlorinated hydrocarbons, is clearly a problem of widespread concern. Improved machinery for bringing the best available scientific and legal expertise to bear on this problem is needed. Damages from these wastes have in the past been few, but the dangers are so great that constant surveillance, and perhaps strict liability as well, is called for. Surveillance cannot take the form of monitoring by an international agency or by individual states simply because the practice of dumping wastes in a big ocean is so difficult to detect. Registration of dumpings of dangerous materials would appear to be the most appropriate first step in surveillance. Registration need not be a mere report of how much of what was dumped where, but might well include a detailed account of safety procedures. Once registration is established, the appropriate international inter-governmental and scientific organizations might consider setting standards for marine dumping of wastes. The activities of the Committee on Space Research (COSPAR) of the International Council of Scientific Unions in setting standards for the biological de-contamination of space equipment is an indication that standard-setting can be based firmly on scientific expertise rather than political expediency. It is important to recognize, however, that COSPAR sets standard for scienti-

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fic activities only. In the case of marine dumping, health and security interests may also be at stake and standard-setting cannot be left solely to marine scientists.

It is only in respect of radioactive waste that there has been international activity on dumping. The explicit reference to the radioactive waste in Article 25 of the High Seas Convention and the resolutions of the 1958 Conference on the Law of the Sea have brought about a series of recommendations by the International Atomic Energy Agency for monitoring and reporting.^{77/} However, no regulatory action has been taken by the IAEA beyond such procedural recommendations. The European Nuclear Energy Agency has supervised a dumping of containerized radioactive wastes.^{78/} With regard to dumping of other wastes, whether containerized or not, there appear to have been no measures taken by international organizations up to the present time. As we have observed above, such action by international organizations could bring into play the obligations placed on states by Article 25 to exercise measures of control. Recent incidents have shown that toxic chemical wastes are unquestionably "harmful agents" which could have serious deleterious effects for human life.

Marine dumping of dispersed and containerized waste would be subject to controls under the draft United Nations Convention on the International Seabed Area, submitted by the United States "for discussion" to the United Nations Seabed Committee. The relevant article would obligate states to conduct all their activities, in the International Seabed Area, which "comprises all areas of the seabed and subsoil of the high seas seaward of the 200 meter isobath adjacent to the coast of continents and islands." "with

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strict and adequate safeguards for the protection of human life and safety and of the marine environment."^{79/} Thus, according to the Legal Advisor of the State Department, a State Party to the Convention could be brought before the Tribunal, an organ of the Authority to be set up by the Convention, "on account of either a potential or actual deposit on the seabed of a material or substance which might harm the marine environment."^{80/}

The marine environment would extend beyond the seabed area and include the waters above from coast to coast. It is presumed that this obligation would extend to dumping, whether dispersed or containerized, if such dumping involved a potential or actual deposit on the seabed. Thus, as Mr. John Stevenson observed in the United Nations Committee, "if the draft Convention were today in force any contracting party would have been able to bring the United States before the Tribunal in respect of its proposed dumping of nerve gas in the ocean" and the United States would be required to abide by the decision of the Tribunal.^{81/} The obligations, combined with extensive provisions for compulsory settlement of disputes and considerable enforcement authority, would be a considerable step beyond the present situation under Article 25 of the Convention on the High Seas. However, this draft is still in its early stages and there can be no telling when, or if, it will be more. There would seem to be reason to continue other efforts towards the regulation of marine dumping, particularly of dangerous containerized wastes, while at the same time pressing for a treaty with more effective provisions for the protection of the marine environment from pollution.

Action in the area of marine dumping need not, however, come only

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through the initiative of international organizations and governments. In a number of countries, action on pollution problems of the "dangerous practices" type has been stimulated largely through the initiatives of private citizens and concerned organizations who have taken pollution problems to court. The effectiveness of such private actions varies with the situation, but they must be considered an important mode of action where governments who are responsible for controlling pollution are participants in practices which may cause pollution. An international mechanism for handling complaints and grievances from private groups as well as governments might contribute to the control not only of marine dumping of wastes but to the control of other dangerous practices as well. Moreover, such a mechanism might be one form in which problems of international concern could be adequately discussed from both the technical and legal points of view.

Some concluding observations

Marine pollution is, of course, but a part of the totality of environmental problems which confront us today. The immediate effects of marine pollution are not as severe as are the immediate effects of pollution of air and inland waters in many countries, though the potential for catastrophe may be greater due to the global character of marine environment and the fact that it is the ultimate receptacle for so many pollutants. It is not, however, either possible or desirable to limit problem-solving efforts to one or even a small number of problems. Marine pollution problems have their place in the total environmental problem and must be dealt with. Nor is it either possible or desirable to view environmental problems solely from a single point of view, and each of the problems

discussed here as a marine pollution problem may well be found discussed elsewhere in a different context. Wastes discharged from coasts are not only a marine pollution problem; they are also a part of the problem of the proper use of the coastal and fluvial margin, a problem which includes land-use planning, urban population growth, the building of dams and the digging of canals. DDT is not only a marine pollution problem; it should also be viewed as an agricultural problem and as a health problem. What we call marine pollution problems here are, in reality, part of a vast overlapping set of problems which will have to be cut up again and again in different ways before the solutions become clear.

The comprehensiveness which is essential to reaching such solutions will be gained only through new efforts to reveal the full complexity inherent in the problems themselves. A purely piece-meal approach, characterized by approaching a single problem without considering its relationship to others would not be adequate. The attempt to achieve comprehensiveness in a single leap may be equally illusory. Even if a global environmental authority could be set-up tomorrow, the difficulties and obstacles will have to be dealt with through a variety of specialized instrumentalities. This has come to be recognized on the international level by the specialized agencies and the United Nations bodies concerned. The decision to hold a United Nations Conference on the human environment in 1972 has had a role in clarifying the various tasks of specialized agencies ^{82/} and has stimulated as well new activities by international non-governmental organizations. ^{83/} Along with these activities there has come to be a greater recognition of the need for regional pollution control

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organs since it is apparent that although pollution is a global problem, it is not uniformly global. Regional arrangements in the Baltic, the North Sea, Mediterranean, Caribbean and perhaps in the Arctic are now underway, and it is likely that these organs will have a decisive part to play in achieving day-to-day practical controls. The adoption of standards and procedures, by international global and regional organizations, even though only recommendatory, can have an added degree of effectiveness by virtue of the open-ended obligation of Article 25 of the Convention of High Seas on States Parties to take anti-pollution measures in cooperation with competent international organizations. On that basis, supervisory and surveillance machinery may be more easily instituted by international organizations pending the conclusion of new treaties.

In short, we need a many-sided institutional approach to achieve the right balance. Pollution problems will not be solved by a single discipline, a single institution or a single wave of enthusiasm. Science can provide certain types of information, but that information will have to be communicated effectively to the international and national decision makers. There is certainly a need for new institutions, though a large part of the solution will lie also in making old institutions more effective. There is as well a continuing need for maintaining the needed pressure from scientists, professional groups and the public at large. The fact that pollution has come to be seen as a problem of great intricacy in a world where many cannot afford to be clean underlines the importance of sustained professional concentration on the whole range of problems.

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FOOTNOTES

1. The Secretary-General of the United Nations has "urgently recommended" the creation of a "global authority" to deal with the problems of the environment." See U. Thant, "The United Nations: the Crisis of Authority," Address to the Fourteenth World Congress of the World Association of World Federalists, (Ottawa, 23 August 1970) as reported in U. N. Press Release SG/SM/1323. An eloquent call for an International Environmental Authority has been made by George Kennan in "To Prevent a World Wasteland: a Proposal," 48 Foreign Affairs 401 (1970). A suggestion for an International Environmental Authority of a somewhat different nature has been made by R. R. Baxter in "International Cooperation to Curb Fluvial and Maritime Pollution," Proceedings, Columbia University Conference on International and Interstate Regulations of Water Pollution held on 12-13 March, 1970, p. 73. See also the statements of Professors Richard A. Falk and Richard N. Gardner in 1970 Proceedings, ASIL. A different approach to establishing international supervision of at least some kinds of marine pollution is found in the Draft United Nations Convention on the International Seabed Area, U. N. Doc. A/AC.138/25 and 9 International Legal Materials 1046 (September 1970) presented to the United Nations Seabed Committee by the United States on 3 August 1970. Under this Convention, the control of marine pollution arising from activities in the International Seabed Area would be under the supervision of an International Seabed Authority entrusted as well with supervising the exploration and exploitation of seabed resources.

For a general treatment of the processes of authority over the seas, see Myres S. McDougal and William T. Burke, *The Public Order of the Oceans* (New Haven: Yale University Press, 1962) and W. T. Burke, *Ocean Sciences, Technology and the Future International Law of the Sea* 1966).

2. See "General Plan and Implementation Programme of IGOSS Phase I," UNESCO Doc. SC/IOC-VI/21 Rev. (27 October 1969).

3. Henry Stommel, "Future Prospects for Physical Oceanography" 168 Science 1536 (26 June 1970). Dr. Stommel, an oceanographer, has expressed misgivings as to the utilities of the proposed global monitoring system to scientists. In his opinion, "...no oceanographic problem has yet been formulated that can justify a data-gathering system on a global scale involving several hundred widely dispersed buoys." He feels that both IGOSS and the U. S. National Data Buoy Project "...do not appear to be aimed at any clearly defined scientific problem."

4. The U. N. General Assembly has passed several resolutions on the need for more research on the oceans and has endorsed an "International Decade of Ocean Exploitation." See U.N.G.A. Res. 2172 (XXI), 2412 (XXIII) and 2467 (XXIII). Research needs are outlined in "Global Ocean Research," a report of the Joint Working Party on the Scientific Aspects of International Ocean Research (set up by the Food and Agriculture Organization, the World Meteorological Organization and the International Council of Scientific Unions), and also in the "Comprehensive Outline of the scope of the Long-term and Expanded Programme of Oceanic Exploration and Research," submitted

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by the Intergovernmental Oceanographic Commission, in Annex to the Note by the Secretary-General to the U.N. General Assembly, U.N. Doc. A/7750 (10 Nov. 1969). Stommel, *ibid.*, comments on the relative merits of these two documents.

5. David R. Zimmerman, "Death Comes to the Peregrine Falcon," New York Times Magazine, 9 August 1970, p. 8.

6. The "Ocean" issue, 221 Scientific American (September 1969) is a good layman's introduction to the scientific aspects of the oceans. For more technical material see reports referred to in note 4 above.

7. Natural submarine seepage of oil occurs in both the Santa Barbara Channel and the Gulf of Mexico, two areas which have recently been the scene of oil pollution from off-shore wells. Oil from submarine seepage was observed in the Santa Barbara Channel as early as 1793, as pointed out by Jan Hahn in "Natural Oil Seepage," XV Oceanus 12 (Woods Hole Oceanographic Institution, October 1969).

8. M. Blumer, "Oil Pollution of the Ocean," XV Oceanus 3 (10 October 1969).

9. Luther J. Carter, "Global Environment: MIT Study Looks for Signs of Danger," 169 Science 660 (14 August 1970).

10. The fate of oil in the marine environment is discussed in Robert W. Holcomb, "Oil in the Ecosystem," 166 Science 204 (10 October 1969); Julian McCaull, "Black Tide," 11 Environment 2 (Committee for Environmental Information, St. Louis, Mo., November 1969); and Claude E. Zobell, "The Occurrence, Effects, and Fate of Oil Polluting the Sea," Proceedings, International Conference on Water Pollution Research (London: Pergamon Press, 1964).

11. Michael H. Horn, John M. Teal and Richard H. Backus, "Petroleum Lumps on the Surface of the Sea," 168 Science 245 (10 April 1970).

12. M. Blumer, note 8 above.

13. Thor Heyerdahl, "Ocean Pollution Observed by Expedition 'RA'" attached to IMCO Doc. OPS/Cir. 21 (23 October 1969) and the GESAMP/30 (20 February 1970). GESAMP documents come from the Joint IAEA/IMCO/FAO/UNESCO/WHO/WMO Group of Experts on the Scientific Aspects of Marine Pollution for which IMCO handles the secretariat responsibilities.

14. The much-publicized attempts to clean oiled birds after both the Santa Barbara Channel and Torrey Canyon oil spills were not successful. According to Julian McCaull, note 10 above, only 450 of 7,849 birds cleaned were alive two months after the Torrey Canyon spill; 198 of 1,653 birds cleaned were alive two months after the Santa Barbara Channel spill.

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15. G. R. Hampson and H. L. Sanders, "Local Oil Spill," XV Oceanus 8 (October 1969).
16. Edward E. Goldberg, "Chemical Invasion of the Ocean by Man," 1970 Year-book of the Encyclopedia of Science and Technology 68 (McGraw-Hill).
17. M. Blumer, note 8 above.
18. Claude E. Zobell, note 10 above.
19. The practices of a number of governments can be found in "Replies to the Questionnaire on Action taken by Governments to implement National Arrangements for Dealing with Significant Spillages of Oil," IMO Doc. OPS/Circ. 19 (3 October 1969) or GESAMP/29 (20 February 1970).
20. "Spectrum," 11 Environment S-3 (September 1969).
21. New York Times, 15 May 1970, p. 67, col. 1.
22. New York Times, 27 April 1970, p. 13, col. 1.
23. Robert W. Holcomb, note 10 above.
24. The problems of oil pollution in the Arctic are discussed in the "Arctic Issue," 1 (NS) Marine Pollution Bulletin (May 1970). The Bulletin is published in England by MacMillan (Journals) Ltd.
25. 499 United Nations Treaty Series, 312. Article 5: "The coastal State is obliged to undertake, in the safety zones, all appropriate measures for the protection of the living resources of the sea from harmful agents."

The U. S. proposed Draft United Nations Convention on the International Seabed Area, note 1 above, would place deep-water drilling beyond the 200 meter isobath on the continental margins under international supervision. It would also place exploration and exploitation of the other resources of the seabed under international supervision. This is a subject likely to be of considerable importance in the future. See J. E. Portmann, "Marine Pollution by Mining Operations, with Particular Reference to Possible Metal-Arc Mining," GESAMP/20 (2 February 1970); Jan Lopuski, "Legal Aspects of Problems Connected with the Development of International Control of Pollution Deriving from the Exploration or the Exploitation of the Seabed and Ocean Floor," GESAMP/16/1 (14 January 1970); Part III of the Questionnaire on Pollution of the Marine Environment, IMO Doc. OPS/Circ. 15 (13 May 1969), attached to GESAMP/22 (10 February 1970); and the Report of the Secretary-General to the General Assembly on "Marine pollution and other hazardous and harmful effects which might arise from the exploration and exploitation of the seabed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction," U.N. Doc. A/7924 (11 June 1970).

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26. 450 United Nations Treaty Series 82, Article 24: "Every State shall draw up regulations to prevent pollution of the seas by the discharge of oil from ships or pipelines or resulting from the exploitation and exploration of the seabed and its subsoil, taking account of existing treaty provisions on the subject." Forty-five States were parties to the 1958 Convention on the High Seas as of 1 October 1970.

A provision applicable to pollution by oil, and to pollution by wastes, in certain cases is Article 24 of the Convention on the Territorial Sea and the Contiguous Zone, 516 United Nations Treaty Series 206, which provides that a coastal state has the right to exercise in the contiguous zone the control necessary to "(a) Prevent infringement of its customs, fiscal, immigration or sanitary regulations within its territory or territorial sea: (b) Punish infringement of the above regulations committed within its territory or territorial sea." This Article is, however, limited to action by a coastal state in a contiguous zone of no more than twelve miles for enforcement of its sanitary regulations (insofar at least as marine pollution is concerned).

27. 9: International Legal Materials 1 (January 1970).

28. Albert W. Koers in "The Enforcement of Fisheries Agreements on the High Seas: A Comparative Analysis of International State Practice," Occasional Paper No. 6 of the Law of the Sea Institute (University of Rhode Island, June 1970) suggests that the enforcement of fisheries agreements may provide some guidance in this area.

There has, however, already been a significant degree of compliance, due in large part to the "clean seas" policies of the major oil companies, see Graham Brockis and Ray Beynon, "Keeping Coasts Clean," 37 New Scientist 196 (25 January 1968). According to the Shell Briefing Service, "Conserving our Environment" (July 1970), "Eighty per cent of the world's tanker fleet now conform to this load-on-top system, and it is conservatively estimated that two million tons of oil per year are now retained which once found their way to the sea."

29. Report of the Tenth Session of the ACC Sub-Committee on Marine Science and its applications, U.N. Doc. CO-ORDINATION/R.793 (10 March 1970), Annex III p. 10.

30. This view was taken by the Institut de droit international in a recent resolution on "Measures Concerning Accidental Pollution of the Seas" adopted at its Edinburgh session, 1969. The Canadian Government has gone much farther than this in the proposed Arctic Pollution Bill which asserts Canadian jurisdiction to prevent pollution over a 100-mile zone in the Arctic Region. Prime Minister Trudeau appealed for an effective international regime to control pollution but said that until such a regime exists Canada had to take steps to ensure that irreversible harm will not occur as a result of negligent or intentional conduct in the Arctic Region. See press release issued by the Office of the Prime Minister, Ottawa, Canada, April 15, 1970.

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31. 9 International Legal Materials 25 (January 1970). The Convention has not yet entered into force.

32. 9 International Legal Materials 45 (January 1970). The Convention has not yet entered into force.

33. The question of how pesticides and other chlorinated hydrocarbons enter the marine environment, as well as the concentrations of chlorinated hydrocarbons in marine life and the effects of these concentrations, is discussed in Justin Frost, "Earth, Air, Water," 11 Environment 15 (July-August 1969) and R. W. Riseborough, "Chlorinated Hydrocarbons in Marine Ecosystems" in Morton W. Miller and George C. Berg, Chemical Fallout: Current Research on Persistent Pesticides (Springfield, Illinois: Charles G. Thomas, 1969). Other pollutants are known to enter the marine environment via the atmosphere, including lead and carbon dioxide. The input of lead from human activities, primarily from the burning of leaded gasoline, is of the same order of magnitude as the input of lead from natural sources, approximately 150,000 metric tons per year. See Edward E. Goldberg, note 16 above.

34. G. N. Woodwell, "Toxic Substances and Ecological Cycles," 216 Scientific American 24 (March 1967).

35. Tony H. Peterle, "Pyramiding Damage," 11 Environment 34 (July-August 1969).

36. Wallace S. Broecker, "Man's Oxygen Reserves," 168 Science 1537 (26 June 1970).

37. Ibid., at 1538.

38. C. F. Wurster in the discussion following R. W. Riseborough, note 33 above.

39. New York Times, 21 August 1970, p. 1, col. 4.

40. Frank Fraser Darling, "Man Against Nature," UNESCO Courier 35 (January 1969).

41. Report of the Director-General to the Twenty-Second World Health Assembly (Boston, 8-25 July 1969), Official Records of the World Health Organization No. 177, Part II, 46.

42. The accounting problem with regard to chlorinated pesticides is not limited to their effects in the marine environment. Their effectiveness as broad-spectrum pesticides has led to increased pest problems in some areas. One case is recounted in some detail in Gordon R. Conway, "A Consequence of Insecticides" in M. Taghi Farvar and John Milton, The Unforeseen Ecological Boomerang (Natural History Special Supplement) 46. See also the Staff Report, "Diminishing Returns," 11 Environment 6 (September 1969).

43. Among the suggestions are the Declaration on the Management of the

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Natural Environment of Europe, adopted at the European Conservation Conference (Strasbourg, 9-12 February 1970), the Draft Rules Governing Certain Changes in the Environment of Man (prepared by David Davies Memorial Institute of International Studies, London) and the Tokyo Resolution of the International Social Science Council's Standing Committee on Environmental Disruption (12 March 1970). The question of what criteria should be applied in formulating environmental policy, and in particular the relative merits of maximizing benefit as opposed to minimizing risk, are discussed in S.V. Ciracy-Wantrup, "Economics of Environmental Policy," *Pacem in Maribus* Vol. V, *The Ocean Environment*, 235 (Center for the Study of Democratic Institutions, Santa Barbara, California).

44. This has been suggested previously by Peter Thacher of the U. S. Mission to the United Nations. See Columbia University Proceedings, Conference on International and Interstate Regulation of Water Pollution, note 1 above, at 102.

45. The amount of DDT used for Malaria eradication is unknown, but it is probably less than 15 per cent of a total of about 300,000 tons per year. See the comments of the delegate of the Netherlands at the Twenty-Second World Health Assembly, note 41 above, at 222.

46. See Oscar Schachter, "Scientific Advances and International Law Making," 55 California Law Review 423 (May 1967), in particular 427-428.

47. Examples of domestic and industrial wastes are listed in the Annex to the Report of the Special Session of the ACC Sub-Committee on Marine Science and its Applications, UNESCO Doc. AVS/9/87 (August 1967), and in the Report of the First Session of the Joint Group of Experts on the Scientific Aspects of Marine Pollution, GESAMP I/II (11 July 1969). Categorizing wastes is a popular exercise of dubious usefulness. The categories used here correspond roughly to those used in the above documents.

48. London Times, 15 May 1970, p. 4.

49. First Annual Report of the Council on Environmental Quality of the United States Government, p. 175 (transmitted to the U.S. Congress, August 1970). For a detailed study of pollution in estuaries, see the United States Department of Interior's National Estuarine Pollution Study (3 November 1969).

50. UNESCO Doc. AVS/9/87, note 47 above.

51. "Spectrum," 11 Environment S-3 (September 1969).

52. Wesley Marx, *The Frail Ocean* (New York: Ballantine Books, 1969). Chapter 2 describes the case of the Florida red tides in some detail.

53. Bengt Lundholm, "The Oceans--Their Production and Pollution with the Baltic as a Case Study," in *Pacem in Maribus* Vol. V, *The Ocean Environment*, 92 (Center for the Study of Democratic Institutions, Santa Barbara, Calif.).

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54. Discharges of mercury from factories are not the only source of mercury in the oceans. Mercurial fungicides are used as seed dressings in many countries. Water run-off from agricultural areas carries some of this mercury to the oceans.
55. J. W. Hedgpeth, "The Oceans: World Sump," 12 Environment 44 (April 1970).
56. G. G. Polikarpov, Radioecology of Aquatic Organisms (New York: Reinhold Book Division, 1966).
57. Note 49 above, at 174.
58. Edward Wenk, Jr., "The Physical Resources of the Ocean," 221 Scientific American 174 (September 1969).
59. "Spectrum," 12 Environment S-1 (April 1970) and Stig H. Fonselius, "Stagnant Sea," 12 Environment 2 (July-August 1970). The Report on which these are based is the Report of the ICES Working Group on Pollution of the Baltic Sea, Cooperative Research Report No. 15, Series A (International Council for the Exploration of the Sea, February 1970).
60. New York Times, 11 July 1970, p. 3, col. 5.
61. New York Times, 19 July 1970, p. 3, col. 1.
62. See, for example, New York Times, 11 September 1970, p. 26, col. 4.
63. Among the relevant IAEA guides and standards are Radioactive Waste Disposal Into the Sea (Safety Series No. 5, 1961), Regulations for the Safe Transport of Radioactive Materials (Safety Series No. 6, 1964 and later editions), Methods of Surveying and Monitoring Marine Radioactivity (Safety Series No. 11, 1965) and Safety Considerations in the Use of Ports and Approaches by Nuclear Merchant Ships (Safety Series No. 27, 1968). The second of these sets forth IAEA standards which, in accordance with the IAEA Statute, must be applied to IAEA activities and to projects which the IAEA assists.
64. As described in the Annex to the Report of the Secretary-General to ECOSOC, "Problems of the Human Environment," U. N. Doc. E/4667 (26 May 1969).
65. These include studies in the Baltic, the North Sea, the Mediterranean and the Caribbean.
66. See the Report of the Second Session of Joint Group of Experts on the Scientific Aspects of Marine Pollution, GESAMP II/11 (20 June 1970) and the background documents listed in Annex II to the Report.
67. Thus, as Michael Hardy observed, a case "would be likely to turn, not on the basic question of the legality or illegality of waste disposal per se,

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but on the extent of knowledge, the foreseeability of harm and the standard of proof required, all matters of which international tribunals (by comparison with national courts) have relatively little experience or case law to guide them." See Hardy, "International Control of Marine Pollution" in the Collection of essays in memory of John McMahon edited by James Fawcett (Royal Institute of International Affairs; London) to be published in 1971.

68. IMCO report on the Questionnaire on Pollution of the Marine Environment, IMCO Doc. OPS/ Circ. 15 (13 May 1969) or Annex I to GESAMP/22 (10 February 1970). The United States Council on Environmental Quality, noting that marine dumping is likely to increase rapidly in the future due to increasing concern about waste disposal on land and in inland waters, has proposed "phasing out all harmful forms of ocean dumping" and the licensing by a federal agency of all permitted dumping. See New York Times, 8 October 1970, p. 1, col. 4 and the report itself, "Ocean Dumping: A National Policy," October 1970.

69. Robert P. Brown and David D. Smith, Interim Summary of "Marine Disposal of Solid Wastes" for the Bureau of Solid Waste Management of the Department of Health, Education and Welfare of the United States Government (24 October 1969).

70. "Monitor," 46 New Scientist 102 (16 April 1970).

71. The proposal for registration is still alive. See GESAMP I/11, note 47 above.

72. "Spectrum," 11 Environment S-2 (July-August 1969).

73. See the Recommendations of the First Meeting of the IOC Working Group on Marine Pollution, 14-17 August 1967. The IAEA has been active in studying marine disposal of radioactive wastes for some time, as described in Annex II to "Marine Science and Technology: Survey and Proposals," Report of the Secretary-General to ECOSOC, U.N. Doc. E/4487 (24 April 1968).

74. London Times, 10 August 1969.

75. New Scientist, note 70 above, and New York Times, 2 April 1970, p. 15 col. 1.

76. There is still some question about this. See Luther J. Carter, "Nerve Gas Disposal: How the AEC Refused to Take Army off the Hook," 169 Science 1296 (25 September 1970).

77. See note 63 above.

78. See the European Nuclear Energy Agency's Radioactive Waste Disposal Into the Atlantic (1968).

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79. Draft United Nations Convention on the International Seabed Authority, note 1 above. Article 1 (2) defines the international seabed area. Article 9 provides for safeguards of the marine environment and Article 23 requires the Seabed Authority to prescribe rules and recommended practices for protection of the environment and prevention of injury to persons, property and resources.

80. Statement before the United Nations Seabed Committee, 20 August 1970.

81. Ibid.

82. See the Report of the Secretary-General, note 64 above, and the Report of the Preparatory Committee for the United Nations Conference on the Human Environment, A/CONF.48/PC/6 (6 April 1970). With regard to marine pollution in particular, see the Prospectus for the FAO Technical Conference on Marine Pollution and Its Effects on Living Resources and Fishing (Rome, 9-18 December 1970) and report pursuant to U.N. General Assembly Resolution 2566, (XXIV).

83. The International Council of Scientific Unions and the International Union for the Conservation of Nature, in particular, are likely to play significant roles in international efforts to solve environmental problems. For a comprehensive and lively account of recent developments in the international non-governmental conservation movements, see Max Nicholson, The Environmental Revolution (London, 1970).

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Paradox of Enrichment: Destabilization of Exploitation Ecosystems in Ecological Time

Abstract. Six reasonable models of trophic exploitation in a two-species ecosystem whose exploiters compete only by depleting each other's resource supply are presented. In each case, increasing the supply of limiting nutrients or energy tends to destroy the steady state. Thus man must be very careful in attempting to enrich an ecosystem in order to increase its food yield. There is a real chance that such activity may result in decimation of the food species that are wanted in greater abundance.

Schemes for increasing primary productivity by enriching an ecosystem's energy or nutrient flow are much in evidence today and are probably a reflection of the increasing demands of the world's population. Such schemes may end in catastrophe.

In 1963, Huffaker, Shea, and Herman (1) reported destabilization of a stable exploitation ecosystem which resulted in the extinction of both the exploiter (an acarophagous mite) and its victim (an herbivorous mite). They produced this result by trebling the herbivore's food density. By using a variety of realistic models, I predict that instability should often be the result of nutritional enrichment in two-species interactions.

Rosenzweig and MacArthur (2) showed that exploitation (or predator-prey) ecosystems do not necessarily exhibit any oscillations. Furthermore, even if there are oscillations, they do not last under ordinary circumstances. If the exploiter is quite proficient at reproducing in the presence of few of its victims, then the ecosystem does not persist. If, however, the victims are relatively proficient at escape or their exploiters have a relatively poor reproductive efficiency or digestive efficiency, then the system will persist in ecological time (3).

The dividing line between persistent and explosive systems is definable from a general graph of exploitation (2). The victim's density V is plotted against P , the exploiter's density. The collection of graph points at which $dV/dt = 0$ is called the victim's isocline. The collection of points at which $dP/dt = 0$ is called the exploiter's isocline. Any point of intersection between the two isoclines is an ecosystem equilibrium, but not all such equilibria will result in a steady state. The usual form of the prey isocline is a hump (4). If the equilibrium is at a point on the left side of the hump, the predator is too proficient and the system will ordinarily not persist. If equilibrium is at a point on the right-

hand (downslope) side of the hump, the system will persist. Thus, the hump's peak is over a critical value of V , V^* . If the equilibrium value of V is larger than V^* , the system is safe. If not, it is in danger of extinction.

If the exploiters do not actually interfere with each other directly—if they never battle or the same individual victim or engage in cannibalism or territorial defense—then the P isocline is a simple vertical line ($V = J$). The position of this line is fully determined by the phenotypes of the exploiter and its victim. It does not change with nutrient flow or energy supply.

To discover the effect of enriching a system, one needs to find how V^* changes as enrichment proceeds. If enrichment increases V^* , then it is jeopardizing the system, because eventu-

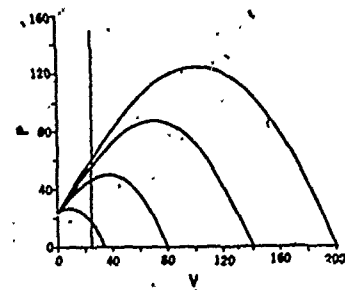


Fig. 1. Isoclines at four levels of productivity ($K = 34, 80, 140$, and 200) when model 4 is used. Symbol V is victim's density; P is exploiter's. The curved lines are V isoclines, which peak over higher values of V at higher K . The vertical line, $V = 25$, is the P isocline. From the slopes of the V isoclines at the points where they intersect the P isocline, one expects only the $K = 34$ system to have a steady state.

ally V^* will be made greater than J .

Briefly, the method is this. Set $dV/dt = 0$ and solve for P . This is the algebraic equation for the V isocline. Take $\partial P/\partial V$. The value of V that satisfies $\partial P/\partial V = 0$ is V^* . If K represents the standing crop of V where $P = 0$, then

K must be directly proportional to the flow rates of limiting nutrients. Thus, enrichment implies K increase. The final step, then, is to obtain $\partial V^*/\partial K$. Since this is always positive, enrichment leads toward system instability.

Each analytical model used is the difference between inherent rate of increase of V and the number of V that die (or are not born) owing to the activities of P .

Assume that each V must receive a quota of nutrients at a rate Q in order just to replace itself. Nutrients flow to the lone individual V at a rate R . Thus, this individual reproduces at a net rate $r(R - Q)$. As V increases, however, each individual V is subjected to intraspecific competition. One may assume that an individual V 's effective "feeding" rate diminishes with increasing V , where a is the victim's competition constant, $1 \geq a > 0$ (5). Thus the per capita reproductive rate is $r(RV^{-a} - Q)$ and the inherent rate is $rV(RV^{-a} - Q)$. From the parentheses one obtains $K = (R/Q)^{1/a}$. Hence, to increase K , R must be increased (a and Q are constant), and $\partial V^*/\partial K$ has the same sign as $\partial V^*/\partial R$ (6).

In addition to the above model, I have used the traditional Pearl-Verhulst logistic $rV(1 - V/K)$ and the Gompertz $rV(\ln K - \ln V)$.

Kill rate models. Lotka and Volterra's approach was to treat the two populations like molecules: kVP [see (7) and references therein]. This has been shown to be inadequate. Gause (7) obtained a reasonable fit to a kill rate curve by taking the square root of V . We can generalize this procedure by taking V to the g th power $0 < g \leq 1$. Thus, a kill rate model is kPV^g .

Another model is based on observations (5, 8) that one lone exploiter will attack $k(1 - e^{-gV})$ victims in a fixed amount of time. Since the exploiters compete only by reducing each other's food supply, P exploiters will kill $kP(1 - e^{-gV})$.

Thus models for dV/dt include

$$dV/dt = rV(RV^{-a} - Q) - kP(1 - e^{-gV}) \quad (1a)$$

$$dV/dt = rV(1 - V/K) - kPV^g \quad (2a)$$

$$dV/dt = rV(RV^{-a} - Q) - kPV^g \quad (3a)$$

$$dV/dt = rV(1 - V/K) - kP(1 - e^{-gV}) \quad (4a)$$

$$dV/dt = rV(\ln K - \ln V) - kPV^g \quad (5a)$$

$$dV/dt = rV(\ln K - \ln V) - kP(1 - e^{-gV}) \quad (6a)$$

In view of the lack of convincing tests of any of the models as a general

case for all systems, I have analyzed all six.

The first step in each analysis is omitted here: solution of each equation for P when $dV/dt = 0$. For example, Eq. 4a becomes

$$P = \frac{rV(1-V/K)}{k(1-e^{-aV})}$$

This set of equations is the set of V isoclines.

Next we obtain $\partial P/\partial V$ and determine the conditions under which this will be zero. These are the V^* equations:

$$R = \frac{Q(V^*)}{(e^{aV^*} - 1)(1-a) - cV^*} \quad (1b)$$

$$K = \frac{(2-g)}{(1-g)} V^* \quad (2b)$$

$$R = \frac{Q(V^*)}{(1-a-g)} \quad (3b)$$

$$K = V^* \frac{(2e^{aV^*} - cV^* - 2)}{(e^{aV^*} - cV^* - 1)} \quad (4b)$$

$$\ln K = \ln V^* + 1/(1-g) \quad (5b)$$

$$\ln K = \ln V^* + 1 + \frac{cV^*}{e^{aV^*} - 1 - cV^*} \quad (6b)$$

The final step requires a small explanation. We need the sign of $\partial V^*/\partial K$ or $\partial V^*/\partial R$. Often the equation systems are easily solved for K or $\ln K$, but not V^* . However, $\partial V^*/\partial K$ is positive if and only if $\partial K/\partial V^*$ is. And $\partial K/\partial V^*$ is positive if and only if $\partial \ln K/\partial V^*$ is. Hence, we can readily proceed with these latter two partial derivatives. Three are positive for any set of values of the constants:

$$\frac{\partial K}{\partial V^*} = (2-g)/(1-g) \quad (2c)$$

$$\frac{\partial K}{\partial V^*} = \frac{2(e^{aV^*} - 1)(e^{aV^*} - 1 - cV^* - c^2V^2/2)}{(e^{aV^*} - 1 - cV^*)^2} \quad (4c)$$

$$\frac{\partial \ln K}{\partial V^*} = \frac{1}{V^*} \quad (5c)$$

Equation 4c is always positive because the MacLaurin series for e^{aV} is $1 + cV + c^2V^2/2 + c^3V^3/6 + \dots$ (see Figs. 1 and 2).

The other three cases are not quite so readily handled. Equation 3b does not always have a positive solution for V^* . In fact V^* is negative if and only if $(1-a-g)$ is also negative. The V isocline of Eq. 3a is humpless for such values of $(a+g)$. Values this great imply intense intraspecific producer competition and also a relatively low tendency for exploiters to become hungry or satiated and to modify their behavior accordingly. In such a system there is no tendency for extinction regardless of productivity.

However, if $(a+g)$ is less than 1, there is a positive V^* and

$$\frac{\partial R}{\partial V^*} = \frac{aQ(1-g)(V^*)^{a-1}}{(1-a-g)} \quad (3c)$$

Clearly Eq. 3c is always positive if V^* is biologically real. Hence, in model 3, if there is any threat of system extinction, it is increased by enrichment.

Models 1 and 6 are similar and most complex. It turns out that Eq. 6b is satisfied by two values of V . One is V^* . Another is a very small value of V that occurs over a trough in the V iso-

cline. Thus, there is ambiguity in the following:

$$\frac{\partial \ln K}{\partial V^*} = \frac{(e^{aV^*} - 1)(e^{aV^*} - 1 - cV^* - c^2V^2)}{(e^{aV^*} - cV^* - 1)^2} \quad (6c)$$

This equation, set to zero, holds for both V^* and the V under the trough. The unstable equilibrium values of V are those between V (trough) and V^* . Model 6c is positive for V^* and negative for V (trough) (9). Hence, as enrichment proceeds, the range of unstable V is increasing at both ends. Therefore again, enrichment unambiguously tends to weaken the steady state. Model 1 has the same characteristics (9).

Until we are confident that the conclusions based on these systems do not apply to natural ecosystems, we must remain aware of the danger in setting enrichment as a human goal.

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References and Notes

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2. M. L. Rosenzweig and R. H. MacArthur, *Amer. Natur.* 97, 209 (1963).
3. Throughout, phenotypes of both species are held constant, ignoring evolution. Current hopes for a high magnitude increase in productivity would probably delay natural selection the time to act.
4. E. J. Maly, *Ecology* 56, 59 (1969); M. L. Rosenzweig, *Amer. Natur.* 103, 81 (1969). The isocline equations of this report are further evidence for the hypothesis, though one is "omission" in some cases and two others have, in addition, an (artificial?) extreme left-hand rise to $+\infty$.
5. K. E. P. Watt, *Can. Entomol.* 91, 129 (1959).
6. This model is sigmoidal. Its point of inflection is at $V = (1-a)^{1/a} K$. Thus it depends on the intensity of intraspecific competition. By L'Hospital's rule, as a approaches 0, $(1-a)^{1/a}$ or \exp in $(1-a)/a$ approaches $1/e$. Then, if intraspecific competition is slight, this equation closely resembles the Gompertz curve. In fact, I doubt if any $a < 0.5$ is readily distinguishable from the Gompertz. However, the Pearl-Verhulst yields an inflection at $K/2$, which is always greater than that predicted from this model.
7. G. F. Gause, *The Struggle for Existence* (Williams & Wilkins, Baltimore, 1934).
8. V. S. Ivlev, *Experimental Ecology of the Feeding of Fishes* (Yale Univ. Press, New Haven, 1961).
9. A proof is on file and available to those who desire it.
10. Iteration was performed with the use of difference equations on a Wang programmable calculator. I thank Dr. Fred Walz for its use.
11. I thank Drs. E. Leigh, II, S. Levin, D. McNaught, L. Segel, and M. Slatkin for valuable comments; and J. Liebesell, whose careful work was helpful in making mathematical errors scarce, if not entirely absent. Supported by the National Science Foundation and the Research Foundation of the State University of New York.

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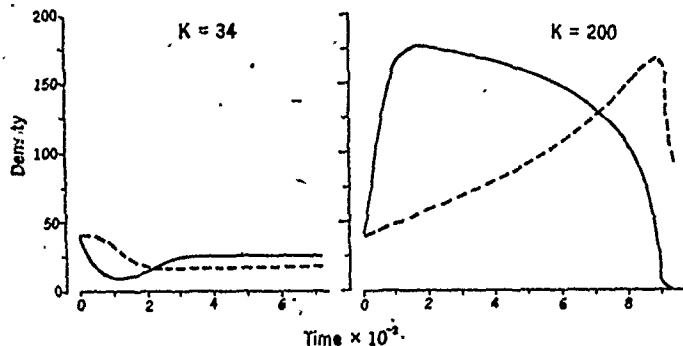


Fig. 2. Iteration of the model 4 exploitation at $K=34$ and $K=200$. Solid curve is V ; dashed curve is P . Enrichment causes the simulated extinction of both species. The exploiter equation used was $dP/dt = AkP(e^{-aV} - e^{-aV^*})$. Time units are in calculator cycles (10).

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REPORTS

Nitrogen, Phosphorus, and Eutrophication in the Coastal Marine Environment

Abstract. *The distribution of inorganic nitrogen and phosphorus and biomass experiments both show that nitrogen is the critical limiting factor in algal growth and eutrophication in coastal marine waters. About twice the amount of phosphate as can be used by the algae is normally present. This surplus results from the low nitrogen to phosphorus ratio in terrigenous contributions, including human waste, and from the fact that phosphorus regenerates more quickly than ammonia from decomposing organic matter. Removal of phosphate from detergents is therefore not likely to slow the eutrophication of coastal marine waters, and its replacement with nitrogen-containing nitrilotriacetic acid may worsen the situation.*

The photosynthetic production of organic matter by unicellular algae (phytoplankton) in the surface layers of the sea is accompanied by, is indeed made possible by, the assimilation of inorganic nutrients from the surrounding water. Most of these substances are present at concentrations greatly in excess of the plants' needs, but some, like nitrogen and phosphorus, occur at no more than micromolar levels and may be utilized almost to the point of exhaustion by the algae. It is, in fact, the availability of these nutrients that most frequently controls and limits the rate of organic production in the sea.

Harvey (1) was among the first to point out that phytoplankton growth caused the simultaneous depletion of both nitrate and phosphate from the ambient seawater. Much has since been written about the interesting coincidence that these elements are present in seawater in very nearly the same proportions as they occur in the plankton (2-4). For example, Redfield (3) reported atomic ratios of available nitrogen to phosphorus of 15:1 in seawater, depletion of nitrogen and phosphorus in the ratio of 15:1 during phytoplankton growth, and ratios of 16:1 for laboratory analyses of phyto-

plankton. This relationship may have resulted from adaptation of the organisms to the environment in which they live, but Redfield suggested a mechanism, the microbial fixation of elementary nitrogen, which could regulate the level of fixed nitrogen in the sea relative to phosphorus to the same ratio as these elements occur in the plankton. In other words, any deficiency of nitrogen could be made up by nitrogen fixation.

Such a process could, in times past, have adjusted the oceanic ratio of nitrogen to phosphorus to its present value, and it may be important in regulating the level or balance of nutrients in the ocean as a whole and over geological time. It is certainly not effective locally or in the short run. As analytical methods have improved and as the subject has been studied more intensively, it has become increasingly clear that the concept of a fixed nitrogen to phosphorus ratio of approximately 15:1, either in the plankton or in the water in which it has grown, has little if any validity.

As early as 1949 Ketchum and Redfield (5) showed that deficiencies of either element in culture mediums may drastically alter their ratios in the algae. They reported (5) nitrogen to

phosphorus ratios by atoms in cultures of *Chlorella pyrenoidosa* of 5.6:1 for normal cells, 30.9:1 for phosphorus-deficient cells, and 2.9:1 for nitrogen-deficient cells. A number of subsequent studies of both algal cultures (6, 7) and oceanic particulate matter (8, 9) have reported highly variable ratios of nitrogen to phosphorus. These ratios are somewhat difficult to interpret in oceanic particulate matter, since living algae may comprise a very small fraction of the total particulate organic matter collected by the usual sampling methods, and the origin and nature of the remaining material are largely unknown. On the other hand, the chemical composition of algae grown in the usual culture mediums may differ significantly from that of naturally occurring organisms. Despite these uncertainties, the following generalizations may be made: (i) ratios of nitrogen to phosphorus from less than 3:1 to over 30:1 (by atoms) may occur in unicellular marine algae; (ii) the ratio varies according to the kind of algae grown and the availability of both nutrients; and (iii) although there is no indication of any "normal" or "optimum" nitrogen to phosphorus ratio in algae, values between 5:1 and 15:1 are most commonly encountered; an average ratio of 10:1 is therefore a reasonable working value.

In seawater, a 15:1 atomic ratio may be typical of the ocean as a whole. But since 98 percent of its volume lies below the depth of photosynthesis and plant growth, such mean values have little relevance to the present discussion. If one considers only the remaining 2 percent of the ocean's volume, the so-called euphotic layer, high ratios approaching 15:1 occur only at the few times and places where relatively deep water is mixed or upwelled into the euphotic layer (9). Over the greater part of the sea surface, the

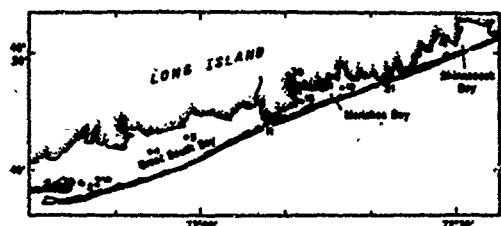
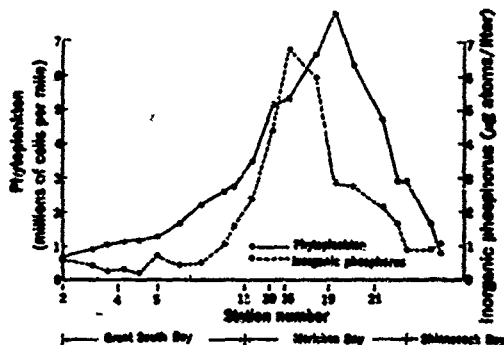


Fig. 1. The distribution of phytoplankton and inorganic phosphorus in Great South Bay, Moriches Bay, and Shinnecock Bay, Long Island, in the summer of 1952. Station numbers on the map (above) correspond to station numbers on the abscissa of the figure (right).



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two elements appear to bear no constancy, in their interrelationship (5, 9-12).

Detailed examination of the nutrient data from the sea surface reveals that, as the two elements are utilized, nitrogen compounds become depleted more rapidly and more completely than does phosphate. This is particularly true when only nitrate-nitrogen is considered. Both Vaccaro (9) and Thomas (13) have pointed out, however, that ammonia may often be quantitatively a more important nitrogen source than is nitrate in surface ocean waters, particularly when nitrogen levels in general become reduced through plant growth. But even when all known forms of available nitrogen are considered together, they are often found to be reduced to levels that are undetectable in the euphotic layer. In this event, almost invariably a significant amount of phosphate remains in solution. There is, in short, an excess of phosphate, small but persistent and apparently ubiquitous, in the surface water of the ocean, relative to the amount of nitrogen available to phytoplankton nutrition. This is true in both the Atlantic (9, 10, 12) and Pacific oceans (11, 13, 14). Thus, the ratio of nitrogen to phosphorus in surface seawater may range from 15:1, where subeuphotic water has recently been mixed or upwelled to the surface, to essentially zero when all detectable nitrogen has been assimilated. Since most of the surface waters of the ocean are nutrient deficient most of the time, nitrogen to phosphorus ratios appreciably less than 15:1 are the common rule.

A puzzling question remains to be answered. If the ultimate source of nutrients is deep ocean water containing nitrate and phosphate at an atomic ratio of 15:1 and if the average phytoplankton cell contains these elements at a ratio of about 10:1, why is it that nitrogen compounds are exhausted first from the water and that a surplus of phosphate is left behind? How can nitrogen rather than phosphorus be the limiting factor? Before turning to this question, we will present two examples of nitrogen as a limiting factor to phytoplankton growth.

Long Island bays. Great South Bay and Moriches Bay are contiguous and connected embayments on the south shore of Long Island, New York, formed by the barrier beach that extends along much of the East Coast of the United States. They are shallow, averaging 1 to 2 m in depth, have a hard sandy bottom, and traditionally

Table 1. Regeneration of nitrogen and phosphorus accompanying the decomposition of mixed plankton [after Vaccaro (18)]. Excess phosphorus (last column) was calculated on the assumption that all nitrogen was assimilated as produced and that phosphorus was assimilated at a nitrogen to phosphorus ratio of 10:1.

Days	NH ₄ + NO ₃ (μg atoms N/liter)	PO ₄ (μg atoms P/liter)	N:P (by atoms)	Excess P (μg atoms P/liter)
0	0.00	0.80	0.0	0.80
7	0.84	0.79	1.1	0.70
17	2.81	0.84	3.3	0.56
30	3.08	1.05	2.8	0.74
48	3.86	0.98	3.9	0.59
87	4.14	1.04	4.1	0.63

have supported a productive fishery of oysters and hard clams. Introduction and growth of the Long Island duckling industry, centered along the tributary streams of Moriches Bay, resulted in the organic pollution of the two bays and the subsequent development of dense algal blooms in the bay waters, to the detriment of the shellfisheries.

As a result of studies by the Woods Hole Oceanographic Institution during the period 1950-55, the ecology of the region and the etiology of its plankton blooms were described in some detail (15). The situation has since changed, but certain of the unpublished results of the study are especially pertinent to this discussion and will be reviewed here.

During the period of dense phytoplankton blooms, the peak in the abundance of phytoplankton occurred in Moriches Bay in the region nearest the tributaries, where most of the duck farms were located. The algal populations decreased on either side of this peak in a manner that suggested dilu-

tion from tidal exchange via Great South Bay to the west and Shinnecock Bay to the east (Fig. 1). Further study suggested that growth of the phytoplankton was actually confined to the tributaries themselves and that the algae in the bays represented a nongrowing population that was able to persist for long periods of time, during which they became distributed in much the same way that a conservative oceanographic property (for instance, freshwater) would behave.

Roughly coincident with the distribution of the phytoplankton was that of phosphate, which reached a maximum concentration of 7.0 μmole per liter in eastern Moriches Bay and fell to levels of about 0.25 μmole per liter at the eastern and western ends of the region (Fig. 1). Phosphate, in fact, was used throughout the study as the most convenient and diagnostic index of pollution from the duck farms.

Analyses were also made for nitrogen compounds, including nitrate, nitrite, ammonia, and uric acid (uric acid is the nitrogenous excretory product of ducks). Except in the tributaries that were in direct receipt of the effluent from the duck farms, no trace of nitrogen in any of the above forms was found throughout the region studied. It was tentatively concluded that growth of the phytoplankton was nitrogen-limited and that the algae quickly assimilated nitrogen in whatever form it left the duck farms, exhausting the element from the water well up in the tributaries before it could reach the bay.

To confirm this theory, water samples were collected from a series of stations (Nos. 2, 4, 5, 11, 15, 30, 19, and 21) in Great South Bay and Moriches Bay and in the Forge River, one of the tributaries of Moriches Bay on which several duck farms were located. These station locations are indicated by number in Fig. 1. The water samples were Millipore-filtered, and each was then separated into three 50-ml portions. The first of these served as a control while the other two received separately NH₄Cl and Na₂HPO₄ · 12H₂O at concentrations of 100 and 10 μmole per liter, respectively. All flasks received an inoculum of *Nannochloris atomus*, the small green alga that was the dominant species in the blooms. The cultures were then incubated for 1 week at 20°C and approximately 11,000 lu/m² of illumination, after which the cells were counted (Fig. 2).

The algae in the unenriched controls increased in number by roughly

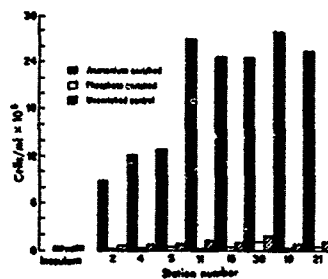


Fig. 2. Growth of *Nannochloris atomus* in unenriched, ammonium-enriched, and phosphate-enriched water collected from Great South Bay and Moriches Bay at the station locations indicated by number in Fig. 1.

two- to fourfold, the best growth occurring in the water collected from within (station 30) or near (stations 11 and 15) the Forge River. No growth occurred in any of the samples enriched with phosphate, with the exception of that taken from the Forge River (station 30), in which the cell count increased about threefold. In fact, the addition of phosphate seemed to inhibit the growth of the algae relative to that observed in the unenriched controls. In contrast, all the water samples to which ammonia-nitrogen were added supported a heavy growth of *Nannochloris*, resulting in cell counts an order of magnitude greater than were attained in the control cultures. About twice as many cells were produced in the samples from Moriches Bay as were produced in samples from Great South

Bay, which suggests that some other nutrient became limiting in the latter series. One might surmise, from the distribution of phosphate in the two bays (Fig. 1), that phosphorus was the secondary limiting factor in Great South Bay, but this possibility was not investigated. There can be little doubt, however, that nitrogen, not phosphorus, was the primary limiting factor to algal growth throughout the region.

New York bight and the eastern seaboard. In September 1969, an oceanographic cruise (R.V. *Atlantis II*, cruise 52) was undertaken along the continental shelf of the eastern United States between Cape Cod and Cape Hatteras. The primary objective of the cruise was to study the effects of pollution of various kinds from the population centers of the East Coast upon the

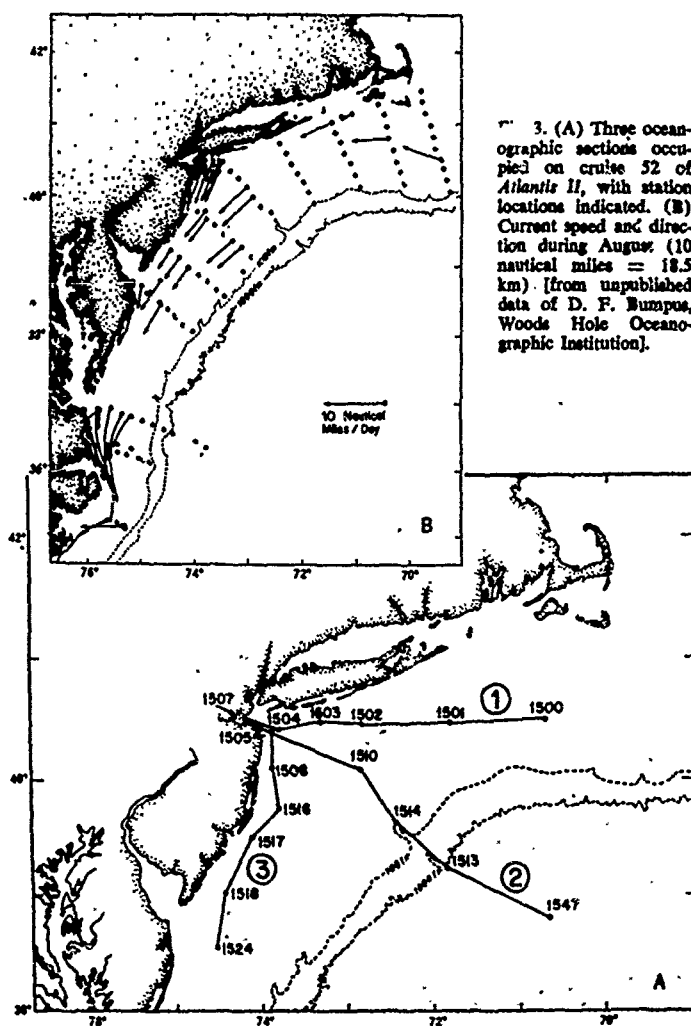
productivity and cycles of organic matter in the contiguous coastal waters. To obtain input data, samples were collected inside the New York bight, at the locations where sewage sludge and dredging spoils from New York City are routinely dumped, as well as from up the Raritan and Hudson rivers.

Of the 52 stations occupied during the cruise, 16 will be discussed here. These stations constitute three sections originating in New York Harbor, one extending eastward along the continental shelf south of Long Island and the New England coast, one extending southeasterly along the axis of Hudson Canyon and terminating at the edge of Gulf Stream, and one running southerly along the coast of New Jersey to the mouth of Delaware Bay (Fig. 3A). The nearshore nontidal currents of the region are predominantly to the south (Fig. 3B), so that pollution emanating from New York Harbor would be expected to spread in that direction roughly along the axis of section 3. Section 1 and the inshore stations of section 2 might be considered as typical of unpolluted or moderately polluted coastal waters, whereas the two distal stations of section 2 (1513 and 1547) should be oceanic in character.

At the inshore end of the three sections, station 1507 was located in heavily polluted Raritan Bay. The water at that location was a bright apple-green in color and contained nearly a pure culture of a small green alga identified in an earlier study of the area by McCarthy (16) as *Didymocystis* sp. Karshikov. Stations 1505 and 1504 are the respective dumping sites for dredging spoils and sewage sludge for the city of New York.

The distribution of total particulate organic carbon at the surface are shown for the three sections in Fig. 4. The measurements were made by the method of Menzel and Vaccaro (17). It is clear from the two sets of measurements that living algal cells made up only a small fraction of the particulate organic content of the water. On the basis of either criteria, one can see that the high content of particulate organic matter characteristic of the New York bight extends seaward for less than 80 km to the east and southeast, whereas evidence of pollution occurs at least 240 km to the south (section 3), along the New Jersey coast to Delaware Bay, presumably the direction of flow of the water flushed out of the bight.

The distribution of inorganic nitro-



gen, as combined nitrate, nitrite, and ammonia, in the surface water of the three sections is shown in Fig. 5. If one considers that the two terminal stations of section 2 (1513 and 1547) are oceanic in character, it is clear that the level of inorganic nitrogen immediately outside New York Harbor, even at the two dumping sites, are as low as, if not lower than, those found in the open sea and that such low values are, in fact, characteristic of the entire continental shelf. Phosphate (Fig. 6), however, presents a quite different picture. Its surface concentrations throughout the shelf area and particularly in the water south of the New York bight are appreciably higher than those observed at the two oceanic stations. As in the Great South Bay-Moriches Bay situation, the available nitrogen from the center of high pollution within the New York bight seems to be utilized by microorganisms as quickly as it becomes available, but there is a surplus of phosphate, which is carried seaward and is distributed throughout the continental shelf.

Experiments similar to those described above were carried out with surface water collected from the 16 stations of sections 1 to 3. This water was Millipore-filtered immediately after its collection and was stored frozen in polycarbonate bottles until used. In the laboratory, the water from each station was divided into three portions, as in the experiments described earlier; one served as a control, one received 10 μ mole of sodium phosphate, and one received 100 μ mole of ammonium chloride. In this instance, the mediums were inoculated with the common coastal diatom *Skeletonema costatum*, the cells of which had been washed and nutrient-starved in sterile, unenriched Sargasso Sea water for 2 days prior to their use. Growth of the cultures at 20°C and 11,000 kl/m^2 of illumination proceeded for 5 days; the results are shown in Fig. 7.

As in the earlier experiment, there was some growth in most of the unenriched controls, and this varied from station to station. Growth in the samples enriched with phosphate was no better and, in several cases, not so good as growth in the control cultures. In contrast, and again as in the bay experiments, heavy growth of *Skeletonema* occurred in most of the samples enriched with ammonia; in several cases growth was ten times or more the growth in the controls and phosphate-enriched samples.

Variability of the growth in the NH_4^+

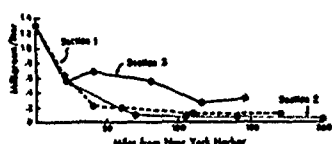


Fig. 4. The distribution of particulate organic carbon along the three sections shown in Fig. 3 (50 miles = 80 km).

enriched samples from station to station again reflects the differential development of secondary nutrient deficiencies, perhaps of phosphate but possibly of one or more other nutrients. This would be expected to occur first in the more offshore stations (see Fig. 6), and such an explanation is consistent with the experimental results. Currently unexplained, however, is the poor growth in the ammonia-enriched samples from stations 1507 and 1505 (two of the heavily polluted stations from within the New York bight), particularly at station 1505, where the best growth occurred in the unenriched and phosphate-enriched series. With the exception of the anomalous results from those two stations, the generalization can be made, consistent with the nutrient distribution picture, that also in these waters nitrogen, not phosphorus, is the primary limiting factor to algal growth.

Sources and mechanisms. To return to the question of why and how nitrogen can limit the growth of phytoplankton when the amount of phosphorus

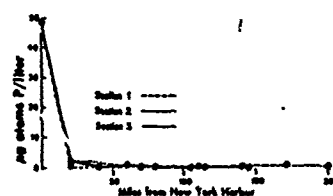


Fig. 5. The distribution of inorganic nitrogen ($\text{NO}_3 + \text{NO}_2 + \text{NH}_4$) along the three sections shown in Fig. 3 (50 miles = 80 km).

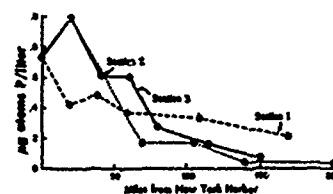


Fig. 6. The distribution of phosphate along the three sections shown in Fig. 3 (50 miles = 80 km).

relative to nitrogen in the plants is greater than it is in seawater, there are probably two explanations. One explanation applies to the ocean in general; the other, to coastal waters and estuaries specifically.

Seasonally or aperiodically, as a result of surface cooling, wind mixing, or other processes leading to vertical instability, the surface layers of the ocean are recharged with nutrients from subeuphotic depths. This mechanism, important though it is as the ultimate source of enrichment of the open sea, probably occurs infrequently. Most of the time, in the thermally stratified, nutrient-impoorished surface waters of the open ocean, organic production is maintained largely through recycling. The supply of nutrients by vertical transport from beneath the thermocline is relatively insignificant. Under these circumstances plant production is limited by the rate of regeneration of the nutrient that is mineralized most slowly. Table 1 lists the relative rates of mineralization of inorganic nitrogen compounds and of phosphate from a mixed plankton tow (18). The excess phosphate left in the water is also shown; the amount was calculated on the assumption that all the nitrogen is assimilated as quickly as it is formed and that phosphate is used at a ratio of one atom of phosphorus for each ten atoms of nitrogen assimilated (see above). Even if nitrogen and phosphorus were assimilated at a ratio of 5:1, an appreciable amount of phosphate would still be left unassimilated. This mechanism is probably responsible for the small but persistent supply of dissolved phosphate observed in surface waters throughout most of the open ocean environment.

The situation is quite different in coastal waters and estuaries. Here the surplus of phosphate may be quite large, as we have seen, and its source is unquestionably the land.

In Great South Bay and Moriches Bay it was pointed out that phosphate could be used as a tracer of the pollution originating from the duck farms located on the tributaries to Moriches Bay. Nitrogen and phosphorus are contained in duck feces in the ratio of 3.3:1 by atoms. Total nitrogen and phosphorus analyses of dissolved and suspended matter in the tributaries and in Moriches Bay itself gave nitrogen to phosphorus ratios of 2.3:1 to 4.4:1, consistent with the presumed origin of this material. About half of the total phosphorus was present as dissolved, inorganic phosphate, with the re-

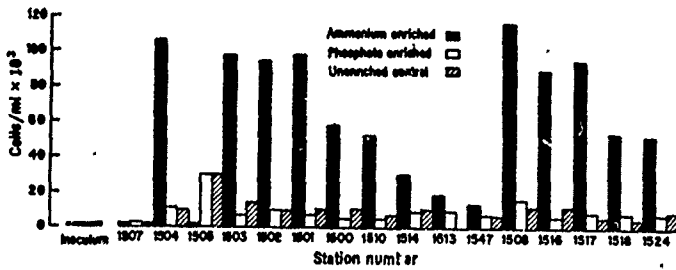


Fig. 7. Growth of *Skeletonema costatum* in unenriched, ammonium-enriched, and phosphate-enriched water from the New York bight collected from the stations shown in Fig. 3.

mainder being tied up in the algae and other particulate matter. All the nitrogen occurred in the latter form. As mentioned earlier, no inorganic nitrogen in any form and no uric acid could be detected anywhere in the water (15).

According to the above data, the ratio of nitrogen to phosphorus in the plankton would be about 6.6 : 1. The population of algae in the area consisted of an almost pure culture of two species of green algae, which were identified at the time as *Nannochloris atomus* and *Silicococcus* sp. The green algae (Chlorophyceae) are characterized by a low nitrogen to phosphorus ratio (5, 6). This fact was believed to be partly responsible for their presence in the bay waters, though other factors such as low salinity and high temperature were also shown to be important selective mechanisms (15).

In the New York bight and the contiguous coastal waters, a high level of phosphate was again measured (Fig. 6). From its distributional pattern there can be little doubt that this material originated in New York Harbor and its tributaries. In Raritan Bay, as mentioned, the phytoplankton consisted almost exclusively of a small green alga, owing presumably to a combination of ecological conditions similar to those that obtained in Great South Bay and Moriches Bay. In the New York bight and the waters farther offshore, conditions more typical of the marine environment prevailed, and the plankton flora consisted of a mixture of diatoms, flagellates, and other forms (19). What is the origin of the surplus phosphate in this case?

From data provided by Pearson *et al.* (20) one can calculate that the nitrogen to phosphorus ratio by atoms in domestic wastes that have been subjected to primary sewage treatment is 5.8 : 1. In wastes that have undergone secondary treatment, the ratio, accord-

ing to Weinberger *et al.* (21), is 5.4 : 1. On the assumption that the ~4 billion kl per day of domestic wastes entering the New York bight from the New York-New Jersey megalopolis have been subjected to something intermediate between primary and secondary treatment, some 90 metric tons of nitrogen and 36 metric tons of phosphorus are discharged into these waters each day. If the phytoplankton that inhabit the area assimilate nitrogen and phosphorus in the ratio of 10 : 1 by atoms (4.5 : 1 by weight), nearly half the phosphate entering the system is in excess of the amount that can be used by the plants.

Eutrophication. As we have seen, phosphate is a convenient index or tracer of organic pollution. Its analysis by conventional colorimetric techniques is quick, accurate, and highly sensitive and is far easier than analysis of other chemical nutrients. Furthermore, it persists when other products of organic decomposition, such as nitrogenous compounds, have disappeared from solution. Thus, domestic wastes can be tracked longer and farther from their source of input by looking at the distribution and concentration of phosphate than by using almost any other criteria. From this fact, it is a short and easy step to the conclusion that phosphate is the causative agent of algal growth, eutrophication, and the other adverse effects associated with organic pollution. In the sea, such is far from true.

There is the possibility, alluded to briefly above, that blue-green algae, and possibly other microorganisms capable of fixing atmospheric nitrogen, may by this process bring enough nitrogen into the biological cycle to balance the surplus of phosphate. Filamentous blue-green algae are common in freshwater lakes, and their ability to fix nitrogen is well demonstrated (22). For this reason, or simply because of a high

natural ratio of nitrogen to phosphorus, there is probably, as Edmondson (23) suggests, "A large class of lakes in which phosphorus is the dominating element," a hypothesis that he has well documented for Lake Washington. As Edmondson has also shown, however, such is true only in the relatively unpolluted condition. During the period when Lake Washington received sewage effluent, phosphate was present in excess quantities relative to the available nitrogen.

In the open tropical ocean, there are also filamentous blue-green algae, of the genus *Trichodesmium*, that are capable of fixing nitrogen, though the process is so slow and inefficient as to be almost undetectable (24). In the more eutrophic coastal waters and estuaries, such algae are almost unknown, and nitrogen fixation has not been demonstrated. Here, as we have shown, it is unquestionably nitrogen that limits and controls algal growth and eutrophication.

Much of the phosphate in domestic waste has its origin in detergents. The fraction of the land-derived phosphate in our coastal waters that can be attributed to this source is difficult to assess but has been estimated to be 25 to 50 percent of the total (25). The total land-derived phosphate also includes human excreta, agricultural runoff, industrial wastes, and other material, all of which vary greatly from place to place. As shown earlier, the nitrogen to phosphorus ratio in domestic waste is slightly higher than 5 : 1 by atoms. Even if as much as half of the phosphate in sewage came from detergents and if all of the phosphate from this source could be eliminated by its complete replacement with other compounds, which is a most unlikely possibility (26), the amounts of nitrogen and phosphorus entering the environment would still be in the atomic ratio of 10 : 1, and no reduction of algal growth or eutrophication could be expected.

If, in fact, the phosphate in detergents is replaced with nitrilotriacetic acid (NTA), as is the current trend in the industry (26), the net effect could be an acceleration and enhancement of the eutrophication process. In sewage treatment (and presumably in nature, if more slowly), NTA undergoes biodegradation and probably yields glycine and glycolic acid as intermediate decomposition products (27). These compounds may be used directly as a nitrogen source by at least some species of unicellular algae (15), or they may

be deaminated to ammonia, which is universally available to phytoplankton.

Coastal waters already receive the sewage of roughly half the population of the United States. To replace a portion of the phosphate in this sewage with a nitrogenous compound and to then discharge it into an environment in which eutrophication is nitrogen-limited may be simply adding fuel to the fire.

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Surface Slicks as Concentrators of Pesticides in the Marine Environment¹

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ABSTRACT

Surface slicks in the marine environment have been found to be effective concentrators of the persistent chlorinated pesticides and as such can indicate the presence of pesticides when they are undeterminable in the surrounding water. Because of the high biological activity associated with slicks and their occurrence throughout the oceans, these findings may be of considerable importance in understanding the distribution of pesticides in the marine ecosystem.

Introduction

The occurrence of pesticide residues in the flora and fauna of estuaries both close to (5) and remote from (11) sites of pesticide application has been reported. Little is known of the method of movement in estuaries, but this undoubtedly depends on a number of factors including the source and type of pesticides, pH, sediments, and microbiological activities (13).

Slicks, or calm streaks on a rippled sea, are often seen on coastal waters and lakes and have been reported as occurring throughout the oceans. They are formed by the ripple-damping action of a surface film of organic matter which occurs naturally on biologically reproductive waters (9). This film has been reported to concentrate dissolved organics and inorganics (19) and marine leptocephali (10). The ability of films to dampen ripples varies radically with the degree of compaction of the film molecules. Such compaction may be caused by horizontally convergent flow in the water surface or by horizontal convergence of the wind stress. The characteristics of the resultant slicks vary with the force producing compaction (9). Thus it seemed reasonable

that slicks might be agents in the transport of pesticides in the marine environment.

It is reported here that pesticide distribution in estuaries and the open sea is influenced by concentration in surface slicks.

Sampling Methods

Samples of surface slicks were collected from Biscayne Bay and the Florida Current during June-August 1968. Samples were collected in 200-ml glass bottles with teflon-lined caps. A sample was taken by holding the lip of the bottle just under the surface of the water and allowing the slick to pull itself into the bottle. Sea water samples were taken in the same manner. At the same time duplicate samples of surface slicks and sea water were taken in prepared bottles for head gas analysis of organic compounds (7, 16).

Analytical Procedures

Sea slicks were directly extracted with hexane (1:10) in the collection bottle. The hexane was then evaporated to 1/10 volume under a stream of high purity N₂ passed through a molecular sieve. The hexane, obtained from Burdick and Jackson Laboratories, Muskegon, Mich., could be concentrated 10² without producing interfering substances.

Analysis of the hexane extracts was done on one of two similar instruments. A Beckman GC-5 gas-liquid chromatograph with a helium arc emission electron capture detector or a specially designed Aerograph A-600B gas-liquid chromatograph with a Ni⁶³ electron capture detector (16). Identification was made by both retention time correlation with FDA certified pesticide standards and by the extractive para-values method of

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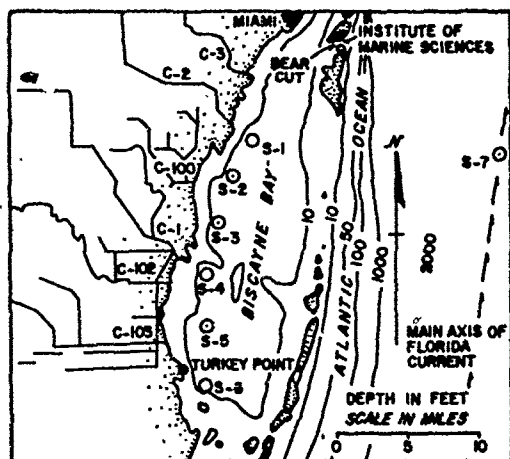
Bowman and Beroza (4). Three different columns were used so that different retention times could be obtained for any particular pesticide. The columns used were 5% QF-1 with 80/90 mesh Gas Chrom Q support, 3% SE-30 with 42/60 mesh Chromosorb G support, and 3% AN600 with 80/90 mesh Anakrom Q support.

Careful attention was given to every phase of the analysis to avoid any contamination or alteration of samples. Blanks and controls were run throughout, and no contamination was found. Experience has shown that, when contamination has occurred, results usually show the presence of an enormous amount of a particular compound in relation to others present.

Sea water and surface slick samples were assayed for acetone, butyraldehyde, and 2-butanone by the head gas method (7, 19). Analysis of the head vapors was done on a Beckman GC-5 gas-liquid chromatograph with dual hydrogen flame ionization detectors. Matched columns of 10% Carbowax 20M with 60/80 mesh Chromosorb W support were used.

Fig. 1 shows the approximate location of the slicks and their relationship to the South Florida Flood Control Canals and the Florida Current. The six canal systems replace natural drainage basins and are the source of surface water discharge into Biscayne Bay from southwest Dade County. The canals were almost continuously flowing into Biscayne Bay during the sampling period due to extremely heavy rainfall. Drainage of the extensive agricultural area southwest of Miami is accomplished exclusively by these canals, particularly C-1 and C-100. Extensive aerial and boat surveys revealed that many of these slicks were semi-permanent features. One slick near the Institute of Marine Sciences, associated

FIGURE 1.—Location of slicks and their relationship to South Florida Flood Control Canals and the Florida Current



with the discharge of the Miami River, was noted every day from June to December 1968. Its width varied greatly from a few to over 100 meters depending on the tide, wind, and water outfall, but its length and location were quite permanent. Permanence of slicks associated with surface water discharges has been reported for other locations (9). Aerial photos revealed that during the period of June-August 1968, about 10% of Biscayne Bay was covered with surface slicks with the coverage rising to 20% in the area around Turkey Point. The increase in slick areas around Turkey Point is probably caused by the instability in the water induced by the large thermal addition from the effluent of a power plant located at Turkey Point.

Table 1 gives the concentrations of pesticides in the surface slick samples. In addition to the pesticides mentioned in Table 1, lindane, heptachlor epoxide, and chlordane were identified tentatively on the basis of retention time but were not confirmed due to unknown interfering peaks on the chromatograms. The values given are the average of five to nine slick samples taken at each location over a period of several weeks during June-August 1968. Some locations were sampled more often only because of their accessibility during inclement weather. Variation was about $\pm 25\%$ and sometimes occurred in duplicate samples of the same slick. A total of 53 samples were taken.

TABLE 1.—Concentration of pesticides in surface slicks

SLICK NUM- BER	RESIDUES IN PARTS PER BILLION					TOTAL
	P.P'- DDT	P.P'- DDE	DEHL- DEIN	p.p'- DDT	AL- DEIN	
S-1	.049	.124	.003	.012	.018	206
S-2	.090	.266	.004	.013	.015	388
S-3	3.460	9.230	.022	.005	.017	12,730
S-4	1.460	2.800	.035	.081	.025	4,480
S-5	.114	.266	.010	.002	.034	426
S-6	.140	.178	.021	.014	.005	358
S-7	.017	.061	.002	.002	.011	693

Of particular interest is the large number of pesticides detected and their distribution. Slicks off canals draining heavily farmed areas contained up to 137 times as much pesticide as surface slicks in the Florida Current. The Current can be taken as a background value for Caribbean waters as local shore water does not reach the main axis of the Florida Current as it flows past Miami.

Samples of sea water taken at the same time and in the same manner as the surface slick samples generally had no detectable amounts of pesticides (less than 1 part per trillion). A total of 51 samples were analyzed. Sea water taken from Bear Cut inlet and distributed through a flowing supply system at the Institute of Marine Sciences did not reveal the presence of any chlorinated pesticides during 1966 and 1967 when it was sampled

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on a weekly basis. The U. S. Geological Survey reports no detectable amounts of pesticide in C-2 and C-100 (12).

Three organic compounds, acetone, butyraldehyde, and 2-butanone, have been recently reported as occurring in the Florida Current and other oceanic waters (7). Head gas analysis for these compounds revealed their presence in all slick and sea water samples taken. The averaged values are given in Table 2. While there was some overall concentration of acetone and butyraldehyde in sea slicks, it was sporadic, independent of location, and was never more than threefold, as compared to the at least 10^3 concentration of pesticides in some of the same slicks. The slight concentration of these three organic compounds may be due to their volatility and solubility.

TABLE 2.—Averaged concentration of organics in sea water and slicks

SAMPLE TYPE	CONCENTRATION OF ORGANICS (MG/LITER)		
	ACETONE	BUTYRALDEHYDE	2-BUTANONE
Slick	.0897	.0267	.0297
Sea Water	.0396	.0259	.0297

Discussion

Although no surveys have been made, pesticides apparently exist in very low concentration in the open oceans. Investigators have found or set very low limits on pesticide concentration in estuaries (12). In an east coast estuary so polluted with DDT that natural populations were probably being limited, DDT concentration was estimated at less than 50 parts per trillion (20).

Croker and Wilson (8) deliberately applied DDT to a tidal marsh ditch at a concentration of 70 parts per billion. In less than 24 hours DDT could only be found in the surface water, and these traces disappeared within 5 days. However, a patch of oil found 8 days after the application contained 133 parts per billion DDT.

Similarly, pesticides accumulated in the surface slicks of Biscayne Bay and the Florida Current. A concentration gradient existed because the slicks with the highest pesticide load occurred closest to the major outfalls. The rapid dropoff of pesticide load in the slicks away from the outfalls adds additional support to the argument that the value for slicks in the Florida Current is representative of Caribbean waters.

Up to a fivefold concentration of dissolved organic carbon and up to a 1500-fold concentration of particulate carbon has been reported for sea water surface film

(19). The findings that acetone, butyraldehyde and 2-butanone, common to all samples, were barely concentrated, if at all, while the pesticides were concentrated by several orders of magnitude, demonstrates that the slick enrichment reported by Williams (19) is a highly selective fractionation and so may be of considerable ecological importance.

The distribution of pesticides in the slicks was similar enough to indicate perhaps some degree of causal relationship to the pesticides recovered from trade wind dust at Barbados, West Indies (15, 17). The higher amount of *p,p'*-DDT and *p,p'*-DDE in slicks may be a result of the continental dust impinging on the surface of the water. Such dust particles would tend to collect in surface slicks (10).

Biological activity was very intense in the water immediately under the slicks in comparison to that in surrounding water. Large, dense schools of small fish (*Clupeidae* and *Engraulidae*) occurred just under the slick. The location of slicks could often be determined before they could be observed by noting the feeding of sea gulls on these fish. Larger game and food fish were often observed feeding on the schools of small fish. Observations and conversations with local fishermen revealed that fishing usually was better when a slick passed under a bridge or a pier. High biological activity from plankton to fish and dolphins in slicks has been carefully documented (1). Numerous other authors have noted aspects of this activity (2, 3, 19). The concentration of pesticides in surface slicks and the high degree of biological activity associated with them may explain several problems of concern to ecologists.

Sutcliffe, *et al.* (18) found that when the rate of downwelling of the converging water masses exceeded the spreading speed of the slick, the film is probably compressed, collapsed, and peptized into colloidal micelles which are carried downward in the water column. These nutrient rich particles could be absorbed and utilized by phytoplankton or could coalesce with other particles and become available to filter feeders, thereby increasing biological activity under slicks. Bahkov (1) has found a large increase in phytoplankton productivity in slicks, yet investigators (21) found that just a few parts per billion of DDT inhibited photosynthesis in marine plankton.

Wide variations in the amounts of pesticide residues are often found among individual fish (14), even those from the same estuary (6). It seems entirely possible that a fish associated with a slick off the C-100 canal would have less than 1/10 the pesticide uptake of a fish associated with a slick just 3 miles to the south.

Acknowledgment

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See Appendix for chemical names of compounds mentioned in this paper.

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GENERAL CIRCULATION PATTERNS IN THE WORLD OCEAN

By Joseph L. Reid

Mathematical investigations of the ocean circulation begin with treatments of geostrophic circulation (Bjerknes and Sandstrom, 1910; Bjerknes, 1911), of Ekman transport (Ekman, 1905), the consequences of evaporation and precipitation (Goldsbrough, 1933), Sverdrup transport (Sverdrup, 1947) and westward intensification (Stommel, 1948); a more general treatment of the wind-driven circulation was given by Munk (1950). There have been discussions by Stommel (1957). Since these basic contributions, a large number of investigators have attempted various solutions for particular processes, areas, or features; examples are the Stommel *et al.* series on abyssal circulation; Wyrski, 1961; Veronis, 1969; Welander, 1969. The most general approach is that being attempted now by Kirk Bryan and his associates at Princeton.

Setting aside the earlier studies that, in the absence of real data, attempted mathematical solutions on more or less idealized oceans, a great deal of qualitative results had been obtained through the measurements of currents (nearly always done only at or near the surface) and measurements of the content of heat, salt, dissolved oxygen, plant nutrients and any other measurable and possibly useful chemical concentration. Recently the concept of age-dating by radioactive isotopes has been used and various measurements made, with some disagreement as to how the results should be interpreted (Blen, *et al.*, 1965; Munk, 1966; Craig, 1969; Kuo and Veronis 1970).

The immediately relevant background materials for a discussion of the marine environment include those qualitative investigations based upon what is known of the distributions of heat, salt, dissolved oxygen, nutrients, and other materials, and what circulation has been directly measured. These two sets of data have led to at least a first-order scheme of general ocean circulation, including exchange with the atmosphere. It is of course quite incomplete and cannot really be tested in a quantitative way over any large areas of the ocean.

Aspects of the exchange between the ocean and atmosphere have been discussed by Jacobs (1951) and various other investigators: lately Stewart (1969) has reviewed much of this work in a popular article.

CIRCULATION

Pertinent qualitative studies of the circulation and some of its effect on the concentrations are given by Stommel (1955), Reid (1962, 1965), Wyrski (1962), Worthington (1965), and Lynn and Reid (1968).

Surface circulation

The major parts of the surface circulation of the world ocean are predominantly wind-driven. In low latitudes near the equator most of the surface waters move westward under the influence of the trades. In high latitudes under the influence of the westerlies most water moves eastward across the ocean. Variations in wind strength as well as the configuration of the continents cause some irregularities in this flow: we find some eastward flow near the equator and some westward flow in high latitudes. Since the continents break the oceans up into three major parts, the westerly and easterly transports feed into each other along the coasts. The West Wind Drift of the North Pacific, for example, divides when it reaches the coast of North America, part turning southward into the California Current system and then westward with the North Equatorial Current; this in turn divides as it nears the Asian continent, a part turning north to contribute to the Kuroshio Current which in turn feeds into the West Wind Drift. This sort of anticyclone is also found in the corresponding latitudes of the Atlantic Ocean and of the South Pacific, South Atlantic, and South Indian oceans. Poleward of these anticyclones cyclonic circulations are similarly imposed, the largest being the Antarctic Circumpolar Current entirely around the continent of Antarctica. This wind-driven surface circulation apparently extends at least some hundreds of meters over most of the world ocean and in the case of the Antarctic Circumpolar flow to depths as great as 4000 meters.

Mixed layer

The water near the surface of the ocean is stirred by the wind and by evaporative and cooling processes. The thickness of this mixed layer and its degree of homogeneity vary both with season and area. Really deep convective overturn is

limited to only two or three places in the world ocean. The thickness of this upper layer may be as great as 300 meters in the western-intensified circulation within the Sargasso Sea and the corresponding parts of the Kuroshio system, or as shallow as 15 or 20 meters along the coasts of the eastern boundary current systems. All of the exchange between the ocean and the atmosphere takes place through this mixed layer. Both the warmest and the coldest waters of the ocean are found at the surface, as well as the most saline and the least saline parts. Since convective stirring is more or less effective throughout this layer, the concentration of dissolved oxygen, for example, is very nearly at equilibrium in the layer. Significant variations from equilibrium occur only in areas of intense upwelling which make up only a very small part of the ocean's surface and in some highly productive areas where intense photosynthesis may produce oversaturation, perhaps as much as 15 or 20% above the equilibrium value during the summer months; these areas also appear to be fairly small in extent compared to the entire area of the world ocean.

Sinking

Downward penetration of the characteristics of the mixed layer such as heat and salt are limited by the stability of the ocean. Figure 1 shows three long sections drawn north-south through the Atlantic, Indian and Pacific oceans. The quantity plotted in Figure 2 is the hydrostatic stability. On the scale of these sections it is not possible to show the details at very shallow depths. Actually the values fall well below the 100 value which is the lowest depicted near the surface. In the mixed layer, of course, which it is impossible to represent properly on this scale, the values approach zero. Since the ocean is stratified in density as well as in other characteristics, any vertical motion of the water is opposed by the vertical density gradient. These figures show the degree of stratification in various areas. The highest values of stability were found just beneath the mixed layer and especially in low and middle latitudes. The Atlantic Ocean, for example, shows three areas of conspicuously low stability where the density stratification offers the least opposition to vertical motion and thus exchange of characteristics.

The first of these is the Norwegian Sea (70° – 80° N). In this basin, overturn from the top to the bottom may actually occur in midwinter. Though this has not really been documented as well as we should like, it is generally accepted that overturn to the bottom does occur there, at least in some winters. This means that in the waters at the bottom of the Norwegian Sea, as well as throughout, the dissolved oxygen concentration should be at the saturation value, since the entire body is in effective contact with the atmosphere. The shallow sill separating the Norwegian Sea from the principal part of the Atlantic Ocean prevents these waters from moving freely into the Atlantic Ocean. They are in fact denser than any of the waters in the Atlantic Ocean and were it not for this sill they would fill the deepest parts of the Atlantic Ocean. The flow through the narrow, shallow passage, however, imposes a high degree of turbulent mixing upon the outflowing waters. They mix with the overlying waters, which are much warmer, to such an extent that their density is decreased and that they do not reach the deepest parts of the Atlantic. Instead they penetrate to a depth of approximately 3500 meters only; the deeper waters are denser and appear to be of Antarctic origin.

A secondary region of low stability is seen at about 60° N in the Atlantic, extending down to about 2000 meters. In this area, which is just south of Greenland, overturn to depths of 2000 or 2500 meters may occur in the wintertime. Downward penetration of heat, salt, dissolved oxygen, nutrients and all other mixed-layer characteristics may take place in this area. This is the deepest downward penetration that occurs in the open ocean. (This excludes, of course, the Norwegian and Mediterranean seas which are cut off by shallow sills from the major parts of the ocean.)

The third area of minimum stability is seen in the Antarctic region. Although the stability everywhere below 500 meters appears to be very low south of 60° S, this does not imply that strong overturn does take place there. Though the stability is low, the characteristics indicate that the water is stratified (Figs. 3–5). There are still strong gradients of temperature and salinity from 500 meters to the bottom, and of dissolved oxygen and nutrients as well. Above this 500-meter layer there is a relatively high stability beneath the mixed layer. Though the surface water is cold in this area the high precipitation causes it to be very low in salinity, and it is very much less dense than the deeper water.

The extremely dense waters which are found at the bottom in the southern part of the Atlantic are formed not by convective overturn between 60 and 70°S as this figure might be taken to suggest but occur instead as a consequence of processes that take place along the continental shelf of Antarctica, particularly within the Weddell Sea. Atlantic water which is fairly saline reaches the coast of Antarctica and on these shelves is made cooler, and by contact with the ice shelves some freezing occurs which causes the salinity to increase; the water is thus made both colder and denser and flows down the slope into the bottom of the Weddell Sea area. From there it extends northward into the Atlantic and eastward around Antarctica into the deeper parts of the South Indian and South Pacific oceans. The Weddell Sea is thus not so effective in bringing mixed-layer characteristics to the bottom of the ocean as it would be if convective overturn did occur from the surface to the bottom in that area.

The Mediterranean Sea behaves much like the Norwegian Sea but its outflow does not reach so deep into the Atlantic Ocean. It is thus not so important to the immediate discussion and will be left out of this brief presentation.

Deep Circulation

The effect of this variation in stability can be seen on the vertical sections of temperature and salinity in the various oceans (Figs. 3-5). The Norwegian Sea, which appears to go through severe mixing, has a small range of temperature and of salinity and in its central area appears to be almost homogeneous. Near 60°N in the Atlantic there is an immense vertical extent of water between 3 and 3.5° C. and of salinity about 34.9‰. The Antarctic part of the Atlantic between 60° S and Antarctica is not very strongly stratified in density but shows a clear variation in temperature and salinity.

Both temperature and salinity decrease toward the bottom. The distribution of temperature and of salinity in particular on the three sections gives some immediate notion as to the nature of the deep and bottom circulation. The Antarctic Bottom Water appears to extend northward in all oceans, becoming warmer and more saline as it moves. The immense body of highly saline water in the Norwegian Sea and North Atlantic is seen to extend southward in the Atlantic Ocean at depths from two to four thousand meters and into the Indian Ocean and Pacific Ocean where it has been carried by the eastward-flowing Antarctic Circumpolar Current. Above these, in all southern oceans and in the North Pacific Ocean, another stratum of low-salinity water extends from about 500 to 1000 meters. Thus, the principal sources of deep and abyssal water throughout the world ocean appear to be the Norwegian Sea and the Weddell Sea. No other parts of the ocean produce water of such high density. The Norwegian Sea is the only one of these water bodies which appears to be filled with waters whose concentrations are characteristic of equilibrium with the atmosphere. The outflow from the Norwegian Sea into the North Atlantic is immediately diluted with other waters which have been away from contact with the atmosphere for some uncertain period.

Exchange with the atmosphere of course takes place everywhere over the surface of the ocean. Gases such as dissolved oxygen which equilibrate rapidly are very near to their equilibrium values throughout the mixed layer. The highest temperatures and the lowest temperatures are found in the mixed layer. The downward penetration of the mixed-layer characteristics by sinking is thus limited to particular areas of the ocean. The nature of the downward penetrations and the return upward of modified water has been studied mostly through distributions of temperature, salinity, dissolved oxygen and nutrients, though recently this system has been examined through the distribution of various radioactive parameters (Bien, *et al.*, 1965; Bolin and Stommel, 1961; Munk, 1966; Craig, 1969). To date not many observations have been made, and the treatment of the samples has varied among investigators. From 1973 to 1975 a more comprehensive selection of water samples will be made along these three sections with the hope of using all of the techniques of geochemistry in studying the deep flow, and in particular the time scale, of the deep ocean.

OCEAN-ATMOSPHERE INTERACTION

Recent studies on the interaction of the ocean and atmosphere have dealt with large-scale as well as small-scale aspects. One of the large-scale features now receiving considerable attention is the deviations of sea-surface temperature

from its normal seasonal value. Areas of abnormally high temperature have been observed to extend over areas more than 6000 km. by 4000 km. and to endure for periods of more than a year. Indeed, such warm areas (and cold areas) seem to be typical of the ocean; coherent patches of anomalous water with large areas and several months' duration are common features of the North Pacific Ocean. Their causes and their effects upon the atmosphere have been investigated by Nemias and by Bjerknes in the enclosed papers.

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Locations of the three sections through the Atlantic, Indian, and Pacific oceans are given by the solid lines. Dark shading indicates depths less than 2000 meters; light shading less than 3000 meters; the black line is the 4000-meter contour.

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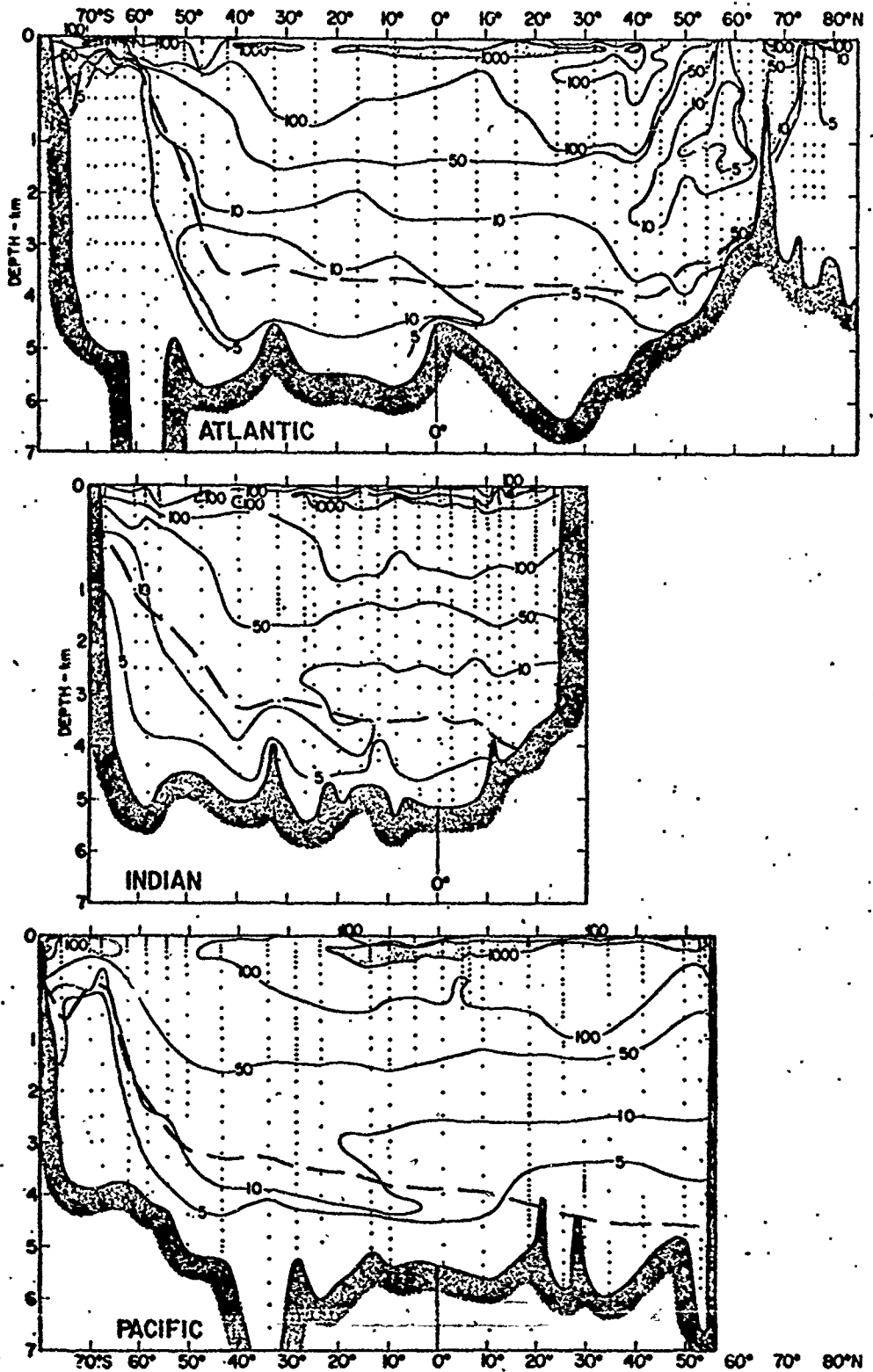


Fig. 2 Hydrostatic stability (resistance to overturn) along north-south sections in the Atlantic, Indian, and Pacific oceans. The quantity is $E = \frac{\delta \rho}{\rho} [10^{-8} \text{ g/cm}^3]$

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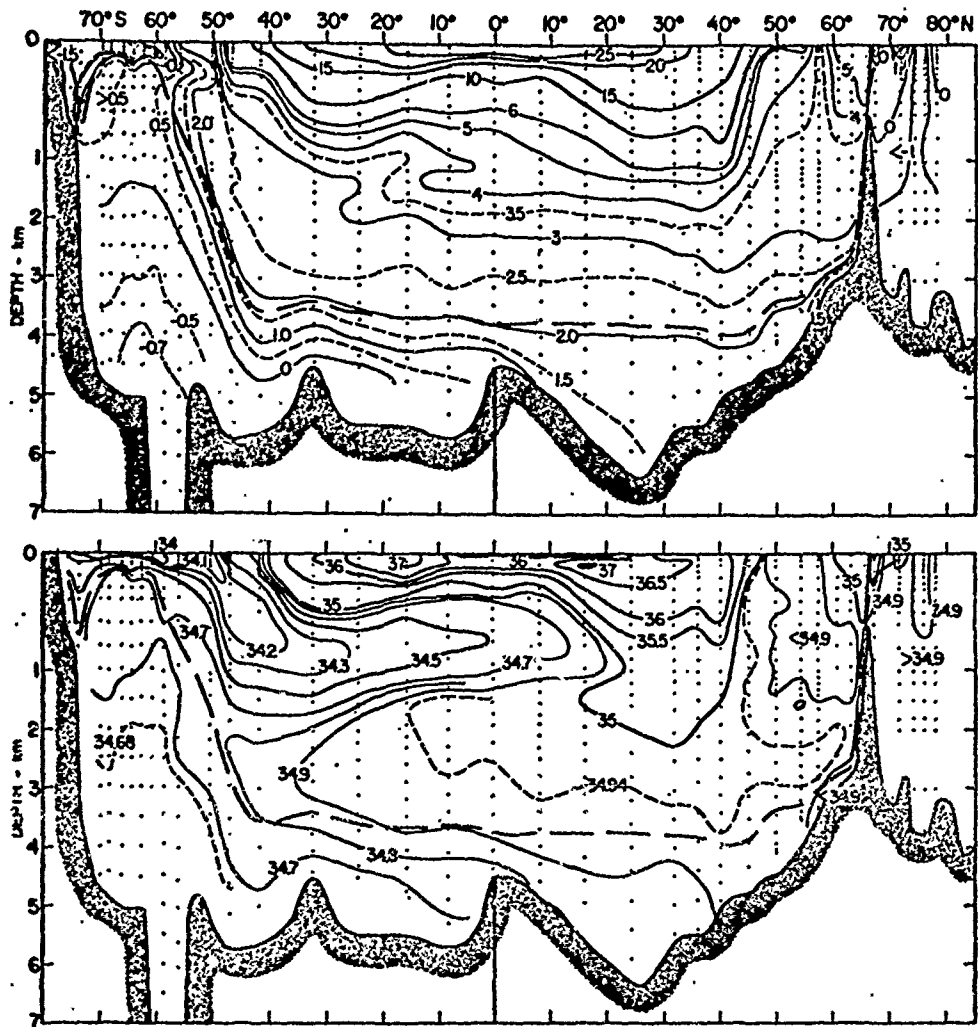


Fig. 3

Atlantic Ocean - Potential temperature and salinity along a north-south section

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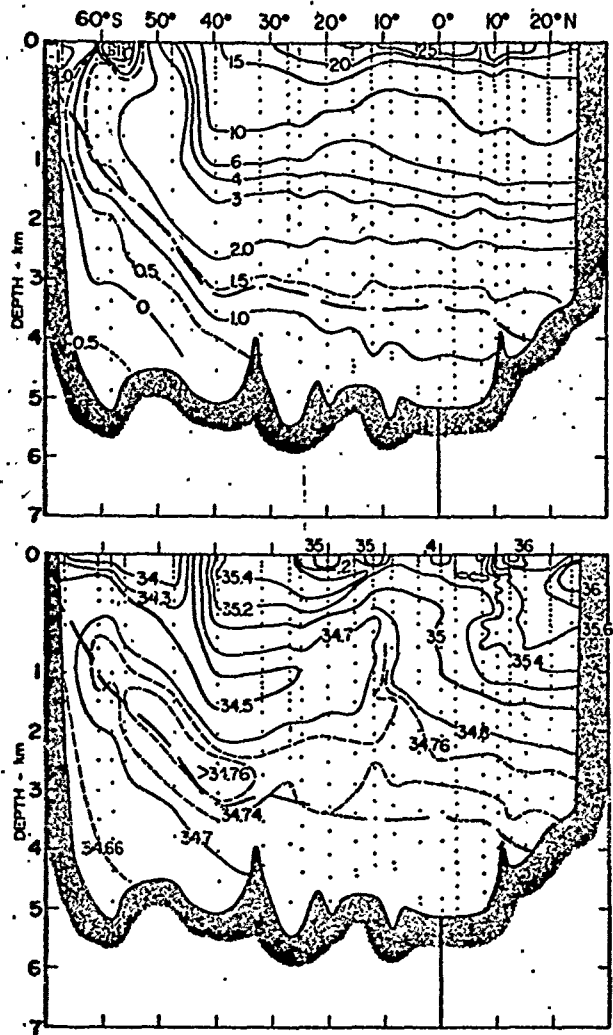


Fig. 4 Indian Ocean - Potential temperature and salinity along a north-south section

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The following report was submitted for the record by Senator Randolph:

MARINE SCIENCES RESEARCH CENTER,
STATE UNIVERSITY OF NEW YORK,
Stony Brook, N.Y., April 28, 1971.

HON. JENNINGS RANDOLPH,
*U.S. Senate,
New Senate Office Building,
Washington, D.C.*

DEAR SENATOR RANDOLPH: Because of your interest in environmental problems of the New York Metropolitan Region and surrounding areas, I am sending you the enclosed report describing waste deposits and their accumulation in the marine waters of this region. The research for this project was supported by the Bureau of Solid Waste Management, Environmental Protection Agency and by the Coastal Engineering Research Center, U.S. Army Corps of Engineers.

If you need further information, I hope that you will feel free to call on me or on my associate, Donald F. Squires, Director of the Marine Sciences Research Center.

Sincerely yours,

M. GRANT GROSS,
Associate Director.

Enclosure: Technical Report No. 8.

MAY 18, 1971.

Mr. M. GRANT GROSS,
Associate Director, Marine Sciences Research Center, State University of New York, Stony Brook, N.Y.

DEAR MR. GROSS: Please excuse my delay in responding to your letter of April 28th regarding the ocean disposal of New York metropolitan wastes.

The Subcommittee on Air and Water Pollution recently concluded hearings on ocean disposal and is preparing to meet in Executive Session on this issue. Because of the appropriateness of your report to these deliberations, I have asked that it be included in the hearing record, and have instructed the Committee Staff accordingly.

Thank you for taking the time to forward it to me.

With warm regards,

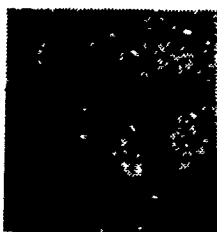
Truly,

JENNINGS RANDOLPH, *Chairman.*

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NEW
YORK

TECHNICAL
REPORT
SERIES #8



SURVEY
OF
MARINE
WASTE
DEPOSITS,
NEW YORK
METROPOLITAN
REGION

BY
M. GRANT GROSS
JOHN A. BLACK
ROBERT J. KALIN
JAMES R. SCHRAMMEL
RAYMOND N. SMITH

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Technical Report No. 8

SURVEY OF MARINE WASTE DEPOSITS,
NEW YORK METROPOLITAN REGION

M. Grant Gross

John A. Black

Robert J. Kalin

James R. Schramel

Raymond N. Smith

April 1971

Marine Sciences Research Center
State University of New York
Stony Brook, New York 11790

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SUMMARY

Chapter 1. Disposal of waste solids in the Coastal Ocean, New York Metropolitan Region

Major sources of wastes and large waste deposits in the coastal waters around the New York Metropolitan Region were surveyed in 1970 to determine their properties. Using the most diagnostic properties of the wastes, the areas covered by the various waste deposits were sampled and approximate boundaries determined. Results of the preliminary stages of those surveys are reported in the various chapters of the report.

Chapter 2. Distribution of waste deposits in New York Harbor and adjacent waters based on total carbon contents and loss-on-ignition (volatile matter)
Loss-on-ignition (volatile matter) or total carbon concentrations provide useful measures of the abundance of carbon-rich wastes on the continental shelf. The area covered by deposits containing more than 2 percent total carbon or 5 percent volatile matter is about 50 square kilometers (20 square miles). Deposits containing more than 1 percent total carbon cover about 100 square kilometers (40 square miles). In New York Harbor, total carbon concentrations are the most useful index of the abundance of organic matter. About 160 square kilometers (62 square miles) or about 40 percent of the harbor is covered by fine grained wastes, containing more than 2 percent total carbon. About one third of the total carbon content of the deposits is added as they accumulate in the harbor. Sewage solids are likely major contributors of carbonaceous materials. Oxidizable carbon and reducing capacity of the deposits is highly correlated with the abundance of total carbon in the deposits.

Chapter 3. Emission spectrochemical analyses of waste deposits in New York Bight

Distribution of samples containing anomalously high total concentrations of chromium, copper, lead, and silver was compared to the distribution of carbon-rich deposits on the continental shelf. Assuming that carbon-rich deposits are indicative of waste accumulation on the continental shelf, the data indicate that lead and copper are the most useful elements for mapping the distribution of wastes. Total lead concentrations in the waste deposits were more than ten times higher than the average lead content of marine organisms or shale (a fine-grained sedimentary rock). Silver is marginally useful for determining waste distributions; total chromium concentrations appear to have little utility.

Chapter 4. Atomic absorption spectrometric analyses of acid-extractable minor elements in wastes and waste deposits

Concentrations of HCl-extractable metals (copper, nickel, chromium, manganese, and iron) correlated well with total elemental concentrations determined by optical emission spectrochemical analyses. Typically about one percent of the total metal concentrations was extractable by HCl, except for nickel where approximately five percent was extracted. Correlation between extractable and total lead concentrations was relatively poor and the extraction efficiency typically exceeded 10 percent. There was no apparent correlation between HCl-extractable and total tin concentrations. The high correlation between total and extractable concentrations of copper, chromium, and iron suggests (but does not prove) that these elements are fairly well dispersed through the samples and generally occur in chemical forms which are little affected by the HCl treatment. Because of the relatively low extraction efficiency of hot hydrochloric acid, it seems unlikely that the various metals studied are likely to be easily extracted from these deposits and to enter the overlying water. Lead is apparently more easily extracted.

Chapter 5. Reconnaissance studies of benthic organisms in New York Harbor and adjacent waters

Only a few groups of pollution-tolerant organisms (nematodes and capitellid worms) were abundant in sediments from the inner portions of New York Harbor.

Benthic animal communities in most of the inner harbor are either drastically impoverished or lacking. Communities of benthic organisms in Lower Bay are less severely affected by pollution. Near the harbor entrance the continental shelf appears to have near-normal bottom-dwelling organisms. The sample location and density of samples in this reconnaissance was inadequate to delineate waste deposits in the major waste disposal sites.

Chapter 6. Biological effects of waste disposal in Western Long Island Sound:
An initial survey

No living foraminifera were found in sediment from the East River near Throgs Neck. Living foraminifera were present in Western Long Island Sound but there were relatively few species. The total number of individual foraminifera (live plus dead) increase toward the west. Waste disposal activities have had little demonstrable effect on the diversity of distribution of foraminifera in Western Long Island. Margalef's Index of Diversity and the number of genera in each sample indicate low diversity values in the extreme western end of the Sound and near the Connecticut shore. Stracods were rare.

Chapter 1

Disposal of waste solids in the Coastal Ocean, New York Metropolitan Region
by M. Grant Gross, Senior Research Oceanographer, Marine Sciences Research Center

Of the approximately 30 million urban and suburban dwellers in the Atlantic Urban Region extending from Boston to Washington, D. C. in 1960, about half lived in the New York Metropolitan Region (Regional Planning Association, 1967), one of the world's most populous metropolitan areas. This area has a long history of urbanization (having exceeded one million inhabitants in 1850) and a comparably long history of intensive industrial activity. During this history, the harbor and adjacent waters have been used to receive various types of wastes. Problems resulting from these disposal activities were well documented early in the present century (Leighton, 1905).

Knowledge of the amount, composition, or distribution of waste deposits in the coastal waters around cities is limited. The disposal activities have been carried on for generations with little concern and often with little or no regulation or record. Being out of sight, the results of these disposal activities and waste accumulation cannot be readily observed. The effects of the waste deposits on the water were often subtle and not readily attributed to a single cause. For all these reasons, little attention has been paid to these wastes or to their disposal. Even in the 1960's planning for waste disposal in the New York Region by several agencies made no mention of these wastes (Regional Plan Association, 1968; DeTurk and Wood, 1970).

Waste disposal activities have substantially modified the Metropolitan Region. Filled wetlands in New York City constitute about one-fifth the area of Manhattan, Brooklyn, Queens and the Bronx. Except for small portions of Jamaica Bay, there is little left of the city's wetland areas. Some wetlands remain in Staten Island, and in the area around the Hackensack River of Northern New Jersey and waste disposal is proceeding in these areas (Regional Plan Association, 1968).

MARINE WASTE DISPOSAL ACTIVITIES

Disposal of wastes in coastal waters is neither new nor restricted to the New York Metropolitan Region. Koch (1960) and Föyn (1965) summarize data on disposal operations worldwide. Brown and Smith (1969) surveyed marine waste disposal activities at selected major ports in the United States and found that approximately 48 million tons of wastes were dumped at sea during 1968. Their survey excluded the Great Lakes and estuaries such as Long Island Sound so that the total discharge is greater. Gross (in press) estimated the total discharge to coastal waters was between 30 and 90 million tons per year with another 25 million tons being discharged to the Great Lakes. Details on the waste discharge in the New York Metropolitan Region were presented by Gross (1970). Four waste disposal sites in the New York Bight (Fig. 1-1) have for many years received large volumes of wastes.

Thirteen sites are actively used for disposal of waste solids in Long Island Sound. Three additional sites are used for disposal of dredged wastes from inlets along Long Islands' south shore. The discharge at two of these sites exceeds a million tons per year. The amount of wastes from various sources in the region and their general mode of disposal are given in Table 1-1. Most of the wastes dumped in the ocean have not previously been included in estimates of waste generation in the New York area (Regional Plan Association, 1968). The types of wastes commonly dumped in the coastal ocean around the New York area are briefly described in Table 1-2.

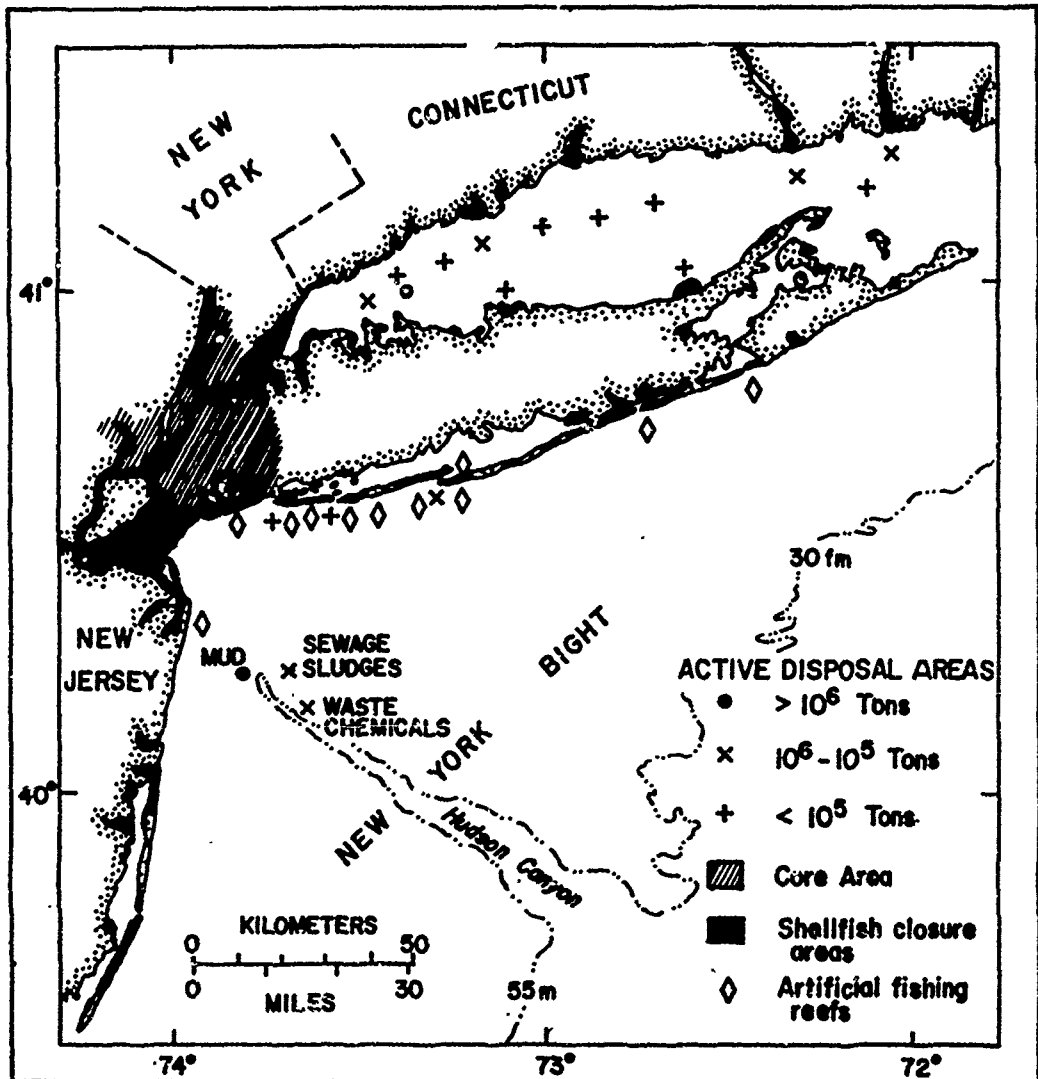


Fig. 1-1. The New York Metropolitan area included in this study and the waste disposal sites actively used in the region. The most densely populated portion of the region (core area) is indicated. Major waste disposal sites in New York Bight, Long Island Sound, and along the south shore of Long Island are shown. Artificial fishing reefs in the area have also been built of various types of wastes, including tires, hulls of barges and ships. Areas closed to the commercial production of shellfish are indicated from data supplied by appropriate agencies in New Jersey, New York and Connecticut.

Table 1-1. Generation and disposal of wastes in New York Metropolitan Region, 1964
Data are expressed in millions of metric tons. Population approximately
19 million

		Discharged To		
	Generated	Atmosphere	Land	Water
Solids				
Refuse, garbage ^a	17.4		12.0	
Dredged wastes ^b	4.9			4.9
Sewage sludges ^b	0.25			0.19
Construction rubble	0.6+		?	0.6
Liquids				
BOD (biological oxygen demand) ^a	0.72			0.46
Gases				
Sulfur dioxide ^a	2.0	1.9		
Dust ^a	0.48	0.29		
Hydrocarbon	1.5	1.4		
TOTAL	27.8+	3.59	12.0+	6.15

a. Regional Plan Association, (1968)

b. Gross (1970c)

Table 1-2. Source and composition of various wastes dumped in coastal waters near New York and their probable impact on these waters.

Waste Solids	Source	Composition	Environmental Effect
Dredged wastes ("dredge spoils")	Corps of Engrs Private dredgers	Silicate sediments (85-95%) mixed with various carbon-rich wastes (5-15%)	Shoaling of waterways Turbidity of waters Oxygen demand Release of materials
Sewage sludges	Municipal waste treatment plants Discharge of untreated sewage	Silicate sediment (45%) Organic wastes (55%) Industrial wastes (?)	Bacteria, viruses released Oxygen demand Floating materials Dissolved constituents
Fly ash	Coal-burning power stations	Silicates-quartz mullite glass	Turbidity, shoaling Absorption
Waste chemicals		Variable	
Liquids	Waste acids Waste caustics		Toxic constituents
Solids	Fermentation wastes Extracted ores	Variable	Oxygen demand Turbidity

Major sources of wastes and waste deposits in the New York Metropolitan Region were surveyed during 1970 to determine those properties that would be most useful to identify waste deposits in the coastal ocean. Surveys were then carried out to determine the distribution of wastes in the region. Results of the preliminary stages of that investigation are reported in the various sections of this report.

The objectives of this study are:

1. Documentation of the marine waste disposal activities in the New York Metropolitan Region
2. Determination of the physical and chemical properties of the wastes and waste deposits
3. Determining the location of these deposits in the waters adjacent to the metropolitan region
4. Preliminary assessment of the effect of these operations on bottom-dwelling organisms

Data obtained from this and succeeding studies will be used for increasing our understanding of the processes involved when wastes are discharged to marine waters. One application is the development of predictive models to permit effects of future waste disposal operations to be evaluated in a preliminary form without danger to the marine environment. Another application is the possibility of modifying present waste disposal activities to lessen deleterious impact on the receiving waters. Ideally, it is desirable to devise means to use the wastes beneficially. One scheme would be to use large volumes of relatively non-toxic wastes to bury other less desirable waste deposits.

Results obtained from this study have importance extending well beyond the New York Region. Similar problems are well known in many other urban areas. In 1965, approximately 11 percent of the world's population lived in urban areas, most of them along coasts, large lakes, or major rivers (Regional Plan Association, 1967). Considering the widespread waste disposal to nearby waterways, submerged deposits of industrial and domestic wastes are doubtlessly quite common in coastal waters around industrialized, heavily populated nations.

Within a single region, environmental problems arising from the mistakes made in the development of one section should be identified and the lessons learned made available to guide the development of nearby regions. Manufacturing operations are commonly displaced in the older, more densely developed portions of metropolitan regions, many of them moving to the suburbs where means of coping with the industrial wastes must be developed. An understanding of the effects of these wastes is essential to planning such facilities.

REGIONAL SETTING

New York Bight is the shallow ocean area over the continental shelf, extending from the western end of Long Island to the entrance to Delaware Bay (Cape May). Circulation of the waters within this area have been described by Ketchum and others (1951). Bumpus (1965) described the residual movements of near-bottom waters as revealed by movements of seabed drifters. Pearce (1969) presented some preliminary data on movements of near-bottom waters in this section also based on movements of seabed drifters. Seasonal temperature and salinity variations were described by Bigelow (1933) and Bigelow and Sears (1935).

The continental shelf (190 km wide) near the entrance to New York harbor is a relatively smooth plain with numerous low ridges and troughs which resemble the barrier islands and associated lagoons exposed along the present shoreline

(Shepard, 1963, p.213). Hudson Channel is the most conspicuous feature of the ocean bottom in this area. It is a shallow channel that extends from the entrance to the harbor across the continental shelf to connect with the head of Hudson Canyon at the continental slope. Hudson Channel is quite straight and has several small basins along the axis of the channel (Shepard, 1963, p.213).

The sediment cover on this part of the continental shelf was described by Shepard and Choee (1936), Uchupi (1963) and Schlee (1964, 1968). Stanley (1969) described the distribution of sediment color and processes controlling it.

Sand dominates the sediment cover in the area near the harbor entrance. Median grain diameters are between 125 and 500 microns, typically around 200-250 microns. There are a few scattered patches of gravel (Uchupi, 1963, p. C133) containing erratics (boulders deposited by glaciers). In the immediate vicinity of the harbor entrance, the sediments are coarser, typically sand and gravel mixtures with median particle diameters of 16 millimeters (Shepard and Choee, 1936). In the axis of the Hudson Channel, the sediments are finer grained; one sample from the Channel had median grain diameter of 67 microns.

There appears to be little natural sediment accumulation in this region. Topographic features on the continental shelf which were cut by rivers flowing across the shelf when it stood as dry land during times of lowered sea level has not been obscured by later sediment accumulations (McKinney and Friedman, 1970). Sand grains are commonly coated with iron rust, typical of relict sediments deposited during the last rise of sea level. The absence of recent sediment cover is further substantiated by recovery from the present sediment surface of fresh-water peat (Emery and others, 1967), elephant teeth (Whitmore and others, 1967) and ancient oyster shells (Merrill and others, 1965). The region's rivers carry little suspended sediment (Dole and Stabler, 1909; Holeman, 1968) and the relatively large estuaries and lagoons along the coast function effectively as sediment traps (Shepard and Choee, 1936; Meade, 1969). Hence, there is little or no sediment deposition to dilute or bury wastes deposited on the continental shelf (Gross, 1970).

New York Harbor lies partly in the states of New York and New Jersey (Fig. 1-1), and has a surface area of about 390 square kilometers (150 square statute miles). It is formed by the drowned lower portions of the Hudson and Raritan River valleys. Lower Bay, the largest part of the harbor, is separated from the open ocean by the sand spits at Sandy Hook, New Jersey and Rockaway Point, on Long Island. The lower portion of the two rivers, their associated connections (East River, Arthur Kill, Kill van Kull, Harlem River) and Newark Bay and Upper Bay are called the Inner Harbor. The portion of the harbor south of Staten Island lying between The Narrows and the harbor entrance will be considered the Outer Harbor.

Sediments in the Inner Harbor are generally fine grained sands and silts (typical median grain diameters between 10 and 60 microns) and contain between 5 and 10 percent total carbon contents (carbon contents are discussed in a later chapter). In the outer portion of the harbor, including Sandy Hook Bay, the bottom is typically covered with sand having median grain diameters between 100 microns and 1 millimeter (average value about 250 microns). In general, carbon contents of Lower Bay deposits were quite low.

Factors affecting sediment distribution and characteristics in New York harbor, include the character of sediment from the Hudson River (McCrone, 1967), the amount and type of wastes discharged within the harbor, tidal currents described by Marmer (1935), and the frequency of dredging within the harbor.

Samples collected during this preliminary survey did not provide sufficient data to permit detailed mapping of deposits in the harbor complex.

Long Island Sound is an estuary with a surface area of about 3380 square kilometers (1220 square statute miles) bounded on the south by Long Island and on the north by the Connecticut coast (Riley, 1956). In this study, only the western portion of Long Island was sampled, an area of about 1000 square kilometers with average depth of about 10 meters (33 feet). In this portion of the Sound, there are no major rivers. The New York Harbor is probably the largest source of low salinity water coming from the East River (Riley, 1956) and of sediment coming from various waste disposal activities (Gross, 1970a). Sediment distribution in western Long Island Sound is fairly complicated and poorly known. In general, surficial sediment in water depths less than about 10 meters in the Sound tends to be either sand or gravel. The bottom of Long Island Sound is fairly flat and covered with carbon-rich silt with a grain diameter of about 30 microns and typically containing less than 25 percent sand (grain diameter 62 microns or larger).

ACKNOWLEDGEMENTS

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Chapter 2

Distribution of waste deposits in New York Harbor and adjacent waters based on carbon contents and loss-on-ignition (volatile matter)

by M. Grant Gross, Senior Research Oceanographer, Marine Sciences Research Center

Distribution of wastes on the continental shelf and in New York Harbor was mapped based on their chemical characteristics. Effects of these waste deposits on bottom-dwelling organisms is discussed in later sections.

The areas included in this survey were New York Bight (1000 square kilometers) and New York Harbor (390 square kilometers). Mapping waste deposits within this large area demanded that the characteristic criteria be picked to obtain the maximum amount of data during the first project year. The desired characteristics included the following:

- Readily interpretable index of waste abundance
- Simple, rapid determination
- Relatively inexpensive analysis
- Good reproducibility, relative standard deviation ± 10 percent or better
- Constituent abundant in wastes, low abundance in natural sediments

With the data obtained from the preliminary surveys of the major types of wastes produced in the region, studies of representative samples of waste deposits, and sediment accumulations (Gross, 1970a,b) it became apparent that a useful index would be one that provided some measure of the abundance of organic matter. Organic matter is contributed directly through the disposal of sewage sludges and carbon-rich dredged wastes. Organic matter is also derived from phytoplankton production stimulated by discharge of nutrients (phosphorous and nitrogen compounds) in various wastes. Petroleum discharges are another source of carbon.

Two measures of the abundance of organic matter were chosen for mapping waste deposits: (1) loss on ignition, and (2) total carbon content. Both are relatively simple to determine in sediment and are easily reproducible in the laboratory. The forms of carbon in soils and the various analytical methods are discussed by Jackson (1958).

EVALUATION OF ANALYTICAL PROCEDURES

Analytical techniques employed are described in Table 2-1. Data are expressed in percent, on a dry weight basis.

Precision (scatter or dispersion of analytical results) and accuracy (difference between average and true results) of the techniques were evaluated by making three to ten separate analyses of chemicals. For simple sugars, the relative error (differences between average result and theoretical carbon content, expressed as a percentage of the true value) of the total carbon analyses was three percent or less (Table 2-2). The relative standard deviation (standard deviation of test results expressed as a percentage of the average result) was typically less than two percent. Normally total carbon and loss-on-ignition analyses were each done separately, whereas carbonate-carbon, oxidizable carbon and reducing capacity were determined sequentially on the same sample. Therefore the accuracy and precision of the entire analytical procedure was evaluated using three simple sugars and glycine (Table 2-3) which were analyzed using the same procedures employed for the sediment samples.

Loss-on-ignition values for chemically pure compounds were within 1 percent of the predicted results, indicating that all the organic matter was destroyed during the heating. Relative standard deviation was also one percent or less. Carbonate compounds (calcium carbonate, sodium carbonate) analyzed under these conditions had weight losses of 0.3 to 0.9 percent, indicating that these carbonate compounds

Table 2-1. Analytical techniques used for screening purposes.

Property Measured (quantity reported)	Procedure	Relative Error (%)	Relative Standard Deviation (%)
Total carbon (percent by weight)	Combustion in O_2 at $T \approx 1500^\circ C$, CO_2 analyzed	2.5	2
Carbonate-carbon (percent by weight)	Acidification (H_3PO_4); CO_2 analyzed after heating sample	1	5
Oxidizable carbon (percent by weight)	$K_2Cr_2O_7$ in H_3PO_4 , heated to $160^\circ C$, CO_2 analyzed	a	5
Reducing capacity (MMQ/g)	$K_2Cr_2O_7$ in H_3PO_4 , heated to $160^\circ C$, excess Cr_2O_7 back titrated with $Fe(NH_4)(SO_4)_2$	a	5
Sulfide (MEQ/g)	Acidification (HCl) of sample with As-free Zn. H_2S precipitated in Zn acetate solution. Excess iodine and HCl added, back titrated with Na Thiosulfate.	a	
Loss-on-ignition, also called volatile matter (percent by weight)	Sample heated in air at $550^\circ C$ for 4 hours or more. Weight loss determined		1

a No standard available

Table 2-2. Average analytical results and standard deviations for individual analysis (in triplicate) of reagent-grade carbonaceous compounds. (Y. J. Liang, analyst)

Compounds	Theoretical Carbon Content ^a (%)	Measured Carbon Contents			Loss on Ignition 550°C (%)
		Total (%)	Oxidizable (%)	Carbonate (%)	
Sugars					
Ribose	40.0	39.6 [±] 0.5	38.2 [±] 0.34	-	99.9 [±] 0.8
Galactose	40.0	40.1 [±] 0.7	-	-	99.5 [±] 0.1
Sucrose	42.1	41.4 [±] 0.7	41.0 [±] 0.5	-	99.9 [±] 0.8
Mannose	40.0	40.1 [±] 0.7	-	-	99.9 [±] 0.8
Glucose	40.0	39.9 [±] 0.7	39.0 [±] 0.7	-	100.3 [±] 0.8
Fructose	40.0	39.0 [±] 1.0	-	-	99.8 [±] 0.8
Maltose	42.1	40.0 [±] 0.5	37.7 [±] 0.7	-	100.2 [±] 0.14
Amino acid					
Glycine	32.0	32.0 [±] 0.8	31.6 [±] 0.8	-	-
Glutamic acid	40.8	40.9 [±] 0.5	41.8 [±] 0.09	-	99.8 [±] 0.8
Fatty acid					
Stearic	76.0	68.5 [±] 1.0	51.1 [±] 2.2	-	99.9 [±] 0.8
Carbonates					
CaCO ₃	12.0	11.8 [±] 0.1	-	11.9 [±] 0.6	0.3 [±] 0.2
Na ₂ CO ₃	11.3	11.5 [±] 0.3	-	11.4 [±] 0.08	0.9 [±] 0.2
Other					
Starch	-	41.6 [±] 1.3	38.8 [±] 1.7	-	99.6 [±] 0.8
Chitin	47.3	45.6 [±] 0.9	43.1 [±] 2.7	-	99.6 [±] 0.2
Coal	84 ^b	83.5 [±] 1.0	34.1 [±] 9.9	-	94.8 [±] 0.8

a. Stecher, P. G. and others (editors). 1968. The Merck Index. Eighth Edition, Merck and Co., Inc. Rahway, N. J. 1713 p.

b. Clarke, F. W. 1924. The Data of Geochemistry. Fifth Edition. U. S. Geological Survey. Bulletin 700. 841 p.

Table 2-3. Accuracy and precision of individual determinations of various carbon constituents analytical procedures (Y.J. Liang, analyst).

Compound	Theoretical Carbon Content (%)	Oxidizable Carbon (%)	Carbonate Carbon (%)	Reducing Capacity (MEQ/gram)
Sucrose	40.0	38.9 ± 0.7	1.9 ± 0.7	162 ± 4
Glucose	40.0	36.6 ± 1.0	2.6 ± 0.2	160 ± 3
Maltose	42.1	33.7 ± 0.9	2.5 ± 0.7	187 ± 14
Glycine	32.0	29.4 ± 0.3	1.6 ± 0.08	121 ± 7

did not decompose at 550° C.

The oxidizable carbon values were within 10 percent of the theoretical carbon contents. The apparent carbonate content was about 5 percent of the theoretical carbon content, suggesting that some oxidation of carbon occurred during decomposition of the carbonate minerals. There is no standard available to permit evaluation of the analytical accuracy of the reducing capacity; typical relative standard deviation of the analyses was 5 percent.

LOSS-ON-IGNITION (VOLATILE MATTER)

Determination of the weight lost by a sample heated to 550°C in a muffle furnace for four hours or more provides an easily determined measure of the amount of organic matter originally present. The technique, called loss-on-ignition for the report, is also known as volatile matter. (APHA, 1965, p.425). Interpretation of loss-on-ignition data is made difficult by several interfering reactions. Water-containing minerals, especially fine grained silicate minerals including clays, partially decompose during heat causing ignition losses to exceed the amount of organic matter in the sample. Other minerals such as sulfides or carbonates also partially decompose, causing a loss in sample weight. Another type of interference causes the ignited sample to gain weight as reduced materials in the sample are oxidized. This is especially likely to happen with samples containing large amounts of metallic iron.

The loss-on-ignition technique works well, however, in clean sands and provides a useful approach to delineate carbon-rich waste deposits on the continental shelf. Sediments beyond the influence of waste disposal activities had typical loss-on-ignition values of 1.2 percent (Fig. 2-1) on the average. Within the designated disposal areas the waste deposits had loss-on-ignition values as high as 13.8 percent and averaging 6.0 percent. If we assume that an ignition loss exceeding 5 percent (five times the background loss-on-ignition values) indicates the presence of wastes, the area of New York Bight obviously covered by wastes containing volatile matter (Fig. 2-2) is about 45 square kilometers (17 square statute miles). The area associated with the disposal of dredged wastes is about seven times as large as the area associated with the disposal of sewage sludges.

TOTAL CARBON

Total carbon content is another measure of the abundance of organic matter from all sources, including such materials as coal and wood. In addition, the procedure also includes carbon derived from the decomposition of carbonate minerals which occurs at the high combustion temperatures. Of these interferences, the potentially most troublesome is presence of large amounts of carbonates. For most of the New York Bight and Harbor area surveyed, this is not serious. Sewage sludges and harbor sediment from the innermost parts of the harbor contained typically 0.2 to 0.3 percent carbonate carbon (Fig. 2-1). In parts of the Lower Bay near the harbor entrance and in East River, the deposits contained recognizable shell fragments. Sediments from these areas contained 0.03 percent carbonate carbon on the average.

Continental shelf sediments more than 10 kilometers from the waste disposal activities contained less than 0.2 percent total carbon. Assuming that sediments containing more than 2 percent total carbon (ten times the background total carbon concentrations) contain waste solids, the area covered by such deposits (Fig. 2-3) is about 50 square kilometers (about 20 square miles). If the 1 percent contour is used, the area apparently covered is about 100 square kilometers (about 40 square statute miles).

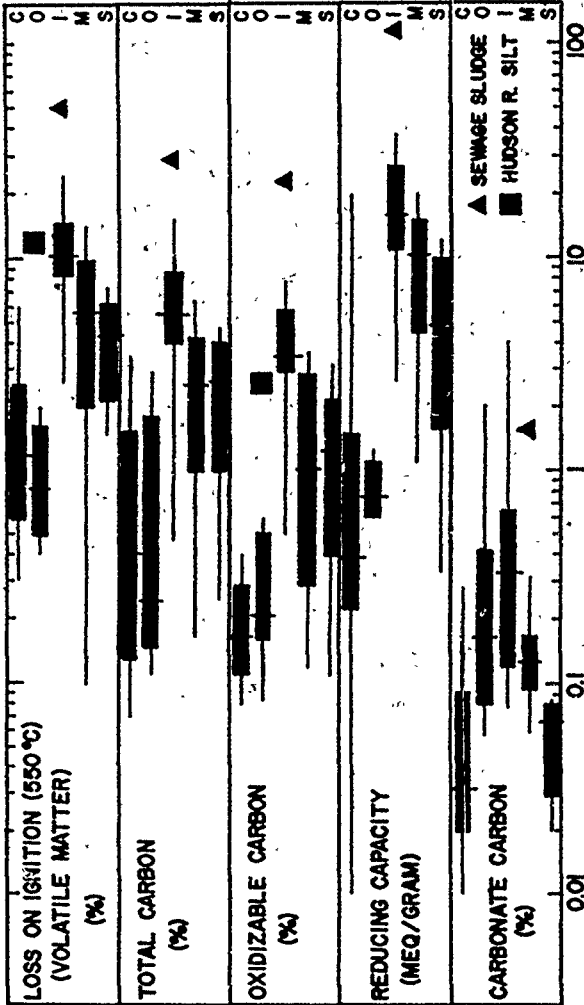


Fig. 2-1. Results of the various analyses for abundance of organic matter and carbon-rich wastes in sediment and waste deposits from New York Harbor and New York Bight. The line represents the range, the vertical line indicates the median concentration and the heavy bar indicates the limits for 70 percent of the results for each analysis. The location of the samples is indicated as follows: C-continent shelf; O-outside the areas affected by waste disposal operations; I-low-carbon deposits in the outer portions of New York Harbor; M-deposits in the inner portions of New York Harbor; S-deposits in the dredged waste disposal areas; S-deposits in the area used for disposal of sewage solids. Data on Hudson River deposits from McCrone (1967).

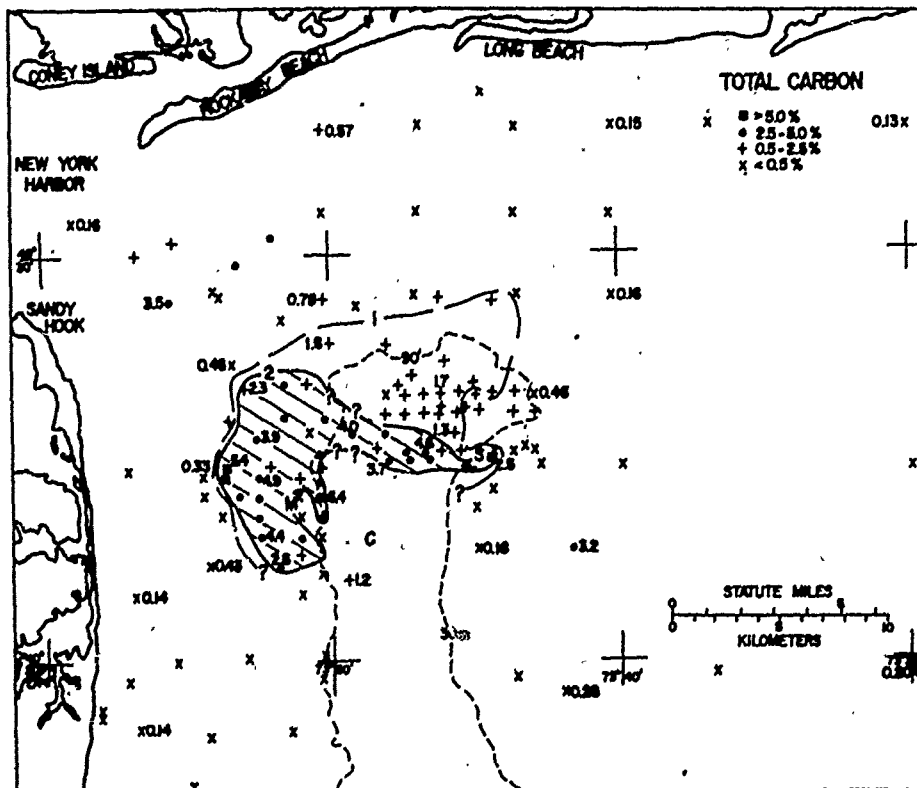


Fig. 2-3. Total carbon concentrations in deposits from New York Bight.

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Within New York Harbor, the abundance of fine-grained sediment limited the utility of the loss-on-ignition technique owing to the interference from partial decomposition of these minerals. For this area, the total carbon abundance was taken as the primary index of waste abundance. These deposits are also the major source of materials dredged from the harbor and dumped in the dredged waste disposal area.

In the harbor deposits (Fig. 2-4) highest carbon concentrations were found in the waterways adjoining the East River, in the Lower Hudson River, and in Newark Bay. Areas affected by strong tidal current (East River) and wave action (Lower Bay) were nearly devoid of carbon-rich deposits. Of the approximately 390 square kilometers of New York Harbor, these data indicate that approximately 160 square kilometers (41 percent of the harbor area) is covered by carbon-rich deposits containing more than 2 percent carbon, with a median concentration of 5.6 percent.

The total carbon concentration of the sands in Lower Bay near the harbor entrance is somewhat lower than the median concentration of total carbon in sands on the continental shelf (Fig. 2-1). In some of the samples collected in Raritan Bay and Lower New York Bay, the fine grained carbon-rich deposits were lying above layers of dead shell on hard sand. Such evidence suggests, but does not prove, that the fine-grained wastes now cover areas that were formerly hard sand bottoms. Additional work, including coring of harbor deposits is necessary to prove such an hypothesis.

The total carbon data permit an estimate of the amount of organic matter added to deposits as they accumulate in the harbor. McCrone (1967) found that silts deposited in the Hudson River upstream from the harbor contained, on the average 2.6 percent oxidizable carbon (Fig. 2-1). Similar but somewhat coarser grained deposits in the harbor contain 3.5 percent oxidizable carbon on the average. The simplest explanation is that these deposits received about two-thirds of their oxidizable carbon from upriver sources including municipal wastes discharged to the river, erosion of soils, and organic matter from aquatic and terrestrial plants. The one-third added to the deposits while accumulating in the harbor likely comes from in part from sewage-treatment effluents and from untreated sewage discharged to the harbor. There is also a contribution of carbon arising from the growth of aquatic plants in the harbor, stimulated by the discharge from sewage treatment plants of phosphorus and nitrogen compounds required by such plants (Ketchum, 1970).

OXIDIZABLE CARBON

Oxidizable carbon provides the most readily interpretable measure of the abundance of organic matter since coal (Table 2-1) and coal ash (Gross, 1970b) are not as completely decomposed as sugars, fatty acids and amino acids, all common constituents in living organisms. Oxidizable carbon is present in low concentrations (median value 0.17 percent) in the sediments of Long Island and offshore from New Jersey. This agrees well with results obtained by K. C. Emery (unpublished); he found that 44 samples in the New York-Bight had average oxidizable carbon contents of 0.17 percent.

Oxidizable carbon is more difficult to determine analytically so that the cost per analysis is about five times higher than the cost per analysis for total carbon content. Also the reproducibility of the analyses is not quite as good as for the total carbon analyses (Table 2-2).

Except for those samples containing large amounts of carbonate, the total carbon concentration is highly correlated with the oxidizable carbon contents (Fig. 2-5). In wastes and waste deposits, the oxidizable carbon normally constituted between 50 and 100 percent of the total carbon content. The increasing

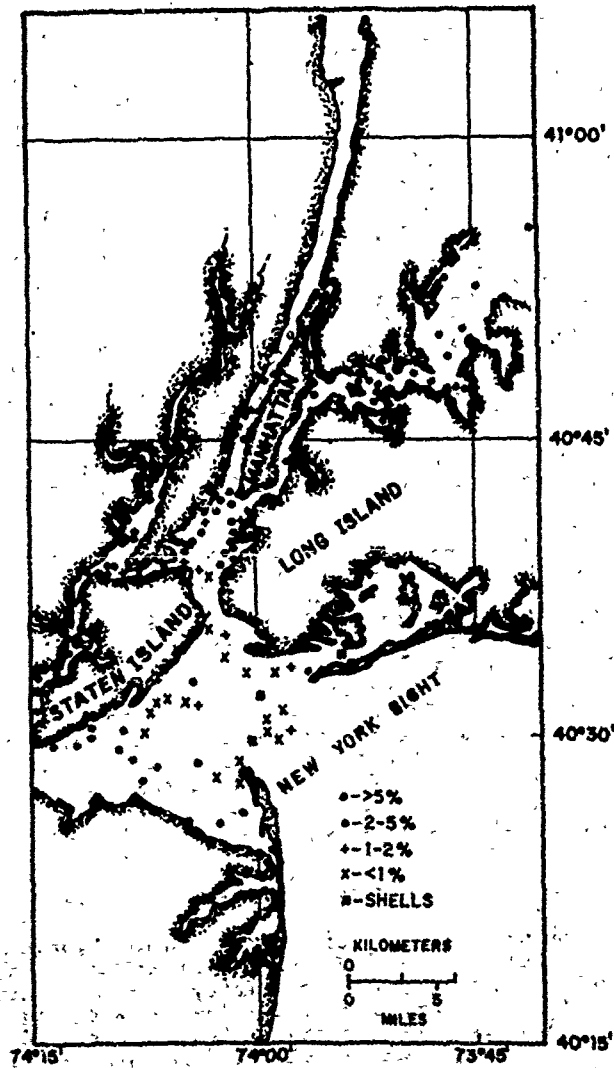


Fig. 2-4. Distribution of total carbon in surficial deposits in New York Harbor and adjacent waters.

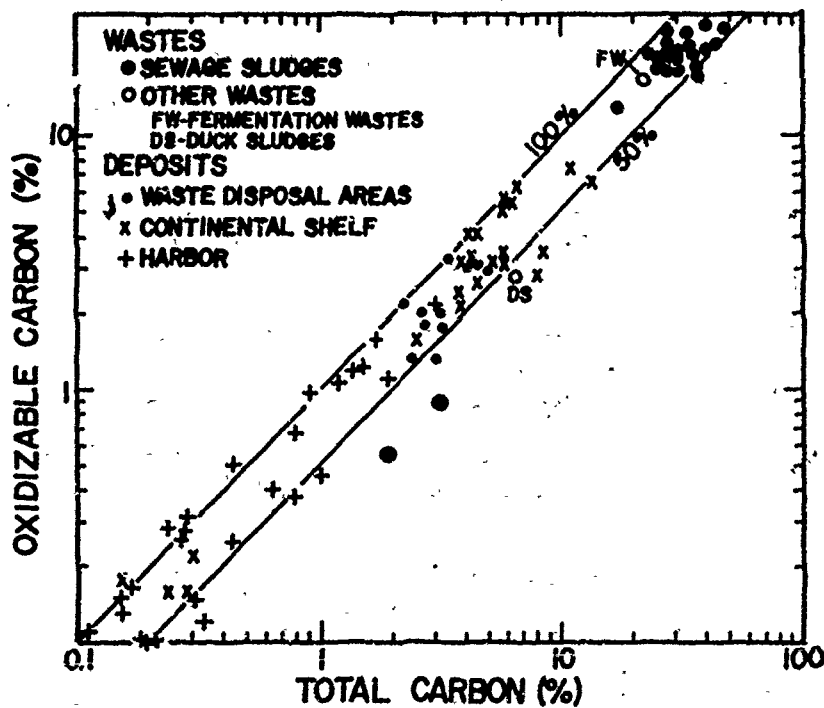


Fig. 2-5. Comparison of total-carbon and oxidizable-carbon concentrations in samples from New York Harbor and New York Bight. The two diagonal lines indicate the relationship expected if 100 percent or 50 percent of the total carbon content was oxidizable by the analytical technique used in this study.

scatter in the data at concentrations less than one percent is a consequence of the relatively large errors involved in measuring small amounts of carbon dioxide given off during the analyses. In short, there was no obvious net advantage of using oxidizable carbon as the index for mapping the distribution of the deposits.

EVALUATION OF ACCURACY OF BOUNDARY LOCATIONS

Locations of samples taken on the continental shelf were determined by Loran aboard the R. V. CHALLENGER from Sandy Hook Marine Laboratories. Performance of the Loran system was not checked during the study but typically such a system provides locations that are rarely farther than within 1 kilometer of the true position (von Arx, 1963, p.227). In this area, the many bouys and coastal landmarks permits somewhat more accurate determinations of sampling locations. I estimate that the sampling positions are probably accurate to within ± 1 kilometer.

Samples collected by the Marine Sciences Research Center vessel R. V. MICMAC were located by radar. In favorable locations, the positions could be located within 0.5 kilometers or less. In less favorable locations, the accuracy of the positions located by radar was comparable to that of Loran determinations, ± 1 kilometer. The uncertainty of sampling locations obviously limits the precision of delineating the boundaries of the waste deposits. The problem is especially acute where the bottom changes sharply over small distances.

Samples used in this study were collected over 17 months and thus do not portray waste distribution at a single instant in time. Instead, the distribution might best be interpreted as indicating the total area affected by waste disposal operations. (Fig. 2-6)

The data were contoured by eye using the concentration limits discussed previously. With the few data available and distributed as shown, there are several possible ways of contouring these data. I chose to delineate the smallest and simplest contiguous area. If the data were contoured to enclose the largest contiguous area, the apparent waste-affected area would be approximately doubled in size. This ignores any uncertainty arising from errors in locating and plotting sampling positions.

A further limitation on the accuracy is imposed by the scarcity of samples in certain areas, such as the southern edge of the sewage-sludge disposal area. Also the available samples did not permit an accurate delineation of the waste-affected area within Hudson Channel.

Results of these analyses indicate that the wastes on the offshore disposal sites are generally close to the designated disposal areas. The dredged wastes which seem to occupy the largest area are within 5 kilometers of the designated spot although slightly displaced toward the entrance to the harbor. The carbon-rich deposits are displaced about 1 kilometer from the designated disposal site for sewage sludges. They too lie closer to the harbor. No samples were available to determine if the Cellar Dirt site (used for disposal of construction wastes and rubble) could be detected on the basis of carbon contents or abundance of organic matter.

The results of this study generally confirm the results obtained by Pearce (1969) although the waste affected areas are somewhat different in size and shape. These results do not, however, provide any compelling evidence of movement of carbon-rich wastes either toward the Long Island or toward the New Jersey coast. There are, indeed, isolated scattered samples containing high total-carbon concentrations lying between the waste disposal areas and the harbor entrance.

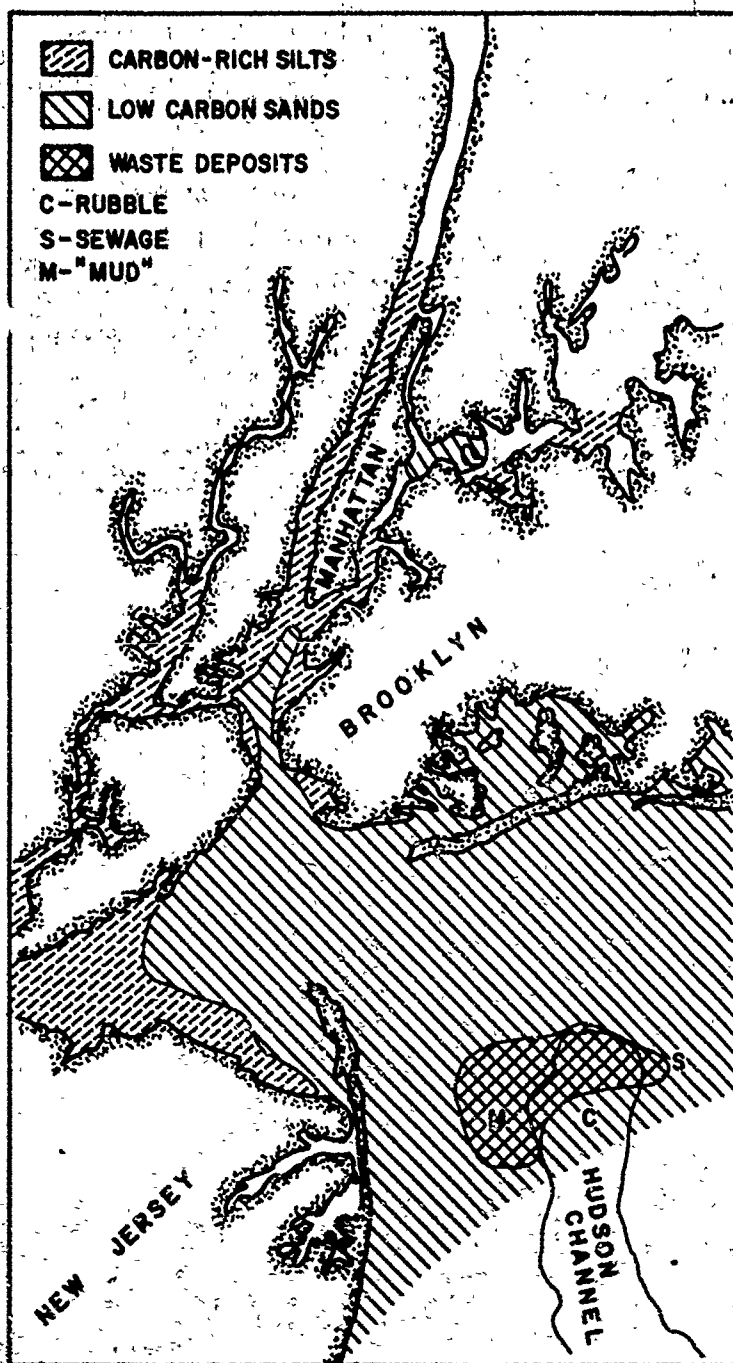


Fig. 2-5. Distribution of carbon-rich deposits in New York Harbor and carbon-rich waste deposits on the continental shelf near the harbor.

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It is possible but not demonstrated, that these isolated occurrences result from shoreward movement of wastes following their discharge in the designated disposal areas. It is also possible that they result from improper disposal operations, from errors in navigation, from illegal dumping, or from leaks in the barges passing over the area in transit to the disposal site. I favor the second alternative in the absence of more compelling data indicating waste movement.

COMPARISON OF DIFFERENT MEASURES OF ORGANIC MATTER ABUNDANCE

The data on the various indices of organic matter in the various deposits suggest that comparison of the results from different techniques might provide useful information about the chemical composition of these wastes in the sediments. For example, total carbon content for the deposits in the dredged waste sites and in the sewage disposal area were essentially identical in the samples analyzed in this study. In the sewage-affected area, the oxidizable carbon contents tended to be somewhat higher than in the dredged waste disposal area. On the other hand, the reducing capacity of the dredged waste deposits was distinctly greater than in the sewage disposal area. Perhaps this can be explained as a result of reduction taking place in harbor sediments prior to dredging and disposal in the offshore sites. Also there may be a larger amount of industrial wastes in the harbor deposits than in the sewage solids.

Chapter 3

Emission spectrochemical analyses of waste deposits in New York Bight
by M. Grant Gross, Senior Research Oceanographer, Marine Sciences Research Center

Previous studies of the major types of wastes dumped on the continental shelf off New York Harbor (Gross, 1970b,c) have shown them to consist of at least three components: organic matter, including sewage solids; silicate minerals, either as fine grained shale-like components or coarser grained sands; and an unknown but presumably small quantity of industrial wastes. The abundance of organic matter (or carbon) in the deposits permits mapping the distribution of carbon-rich wastes on the continental shelf where the natural sands and gravels contained little carbon prior to the waste disposal activities.

Although the organic matter and various industrial wastes occur together in sewage sludges or in harbor sediment, it is desirable to determine how the metal-rich constituents behave after disposal on the continental shelf. There was no assurance that all waste components would follow the same patterns in the ocean.

Previous studies showed that several elements were present in the wastes at concentrations in excess of those observed in sediments or ancient rocks unaffected by waste disposal activities (Gross, 1970b,c). Elements most useful to detect the presence of industrial wastes were: chromium, copper, lead and tin.

Optical emission spectrochemical techniques were used because of the ease of making analyses, their sensitivity for these metals, and ability to determine the total elemental concentration of about 24 elements regardless of the chemical form of the elements in the dried samples (Gross, 1970b). Although tin was easily detectable in the sewage sludges it was frequently below detection limits in the harbor sediments and waste deposits and therefore not usable for this purpose. Silver, however, was easily detectable and occurred in concentrations greatly in excess of those observed in normal sediments, soils, or marine organisms and was, therefore, included in the survey.

The major purpose of this phase of the investigation was to assess the feasibility of using emission spectrochemical analyses for use in delineating waste deposits on the continental shelf. A limited number of samples was analyzed, and it was thus not possible to determine independently the limits of the waste deposits from the elemental analyses. Data from the analyses for carbon or loss-on-ignition were used to delimit areas affected by waste disposal activities.

Details and limitations of semi-quantitative optical emission spectrometry were discussed by Harvey (1965) and were previously reviewed and evaluated for purposes of this study (Gross, 1970b). Results obtained from spectrochemical analysis will be discussed in the next chapter and compared to results obtained from hydrochloric acid extraction and analysis by atomic absorption spectrometry.

SAMPLING OF SEDIMENTS AND WASTE DEPOSITS

The uppermost few centimeters of the deposits were sampled in various portions of New York Harbor and the adjacent parts of the New York Bight. Sediment samples from the New York Bight area were collected by personnel of the Sandy Hook Marine Laboratory using a Smith-McIntyre grab (Pearce, 1969,p.9). Sediments from New York Harbor were collected by personnel from the Marine Sciences Research Center using a Shippek grab sampler (Shippek, 1965) operated from the R. V. MICHAC. In every instance only surficial deposits were sampled.

INTERPRETATION OF RESULTS

The median value, range, and an indication of the dispersion of the data for the four elements studied are shown in Fig. 3-1. The figure also includes data on the average abundance of these four elements in some sediments and sedimentary rock, in marine plants, and in sewage sludges from the New York Metropolitan Region (Gross, 1970b).

Chromium was easily detected in all the samples analyzed. Highest concentrations were found in surficial deposits from the inner portion of New York Harbor, including the Lower Hudson River, East River, Upper Bay, Newark Bay, and Arthur Kill. There the concentrations of total chromium were about five times as great as those observed in shale (Bowen, 1966) and about 400 times as great as those observed in marine organisms.

Distribution of wastes (based on their carbon contents) was not obviously or simply related to total chromium concentration in deposits near the sewage sludge disposal site (Fig. 3-2). The highest chromium values observed on the continental shelf area were in samples taken near the dredged waste disposal site.

Based on these results, it appears that total chromium is too abundant and too widespread in naturally occurring continental shelf sediment to provide a readily interpretable index for determining the distribution of wastes coming from the metropolitan region. Perhaps more sophisticated extraction and analytical procedures would permit more useful data to be obtained using the different forms of the chromium in silicate minerals and in industrial wastes. These data should clearly not be interpreted to mean that chromium from industrial wastes has been distributed over the entire continental shelf area studied. If chromium distribution is to be used to delineate waste deposits, clearly more work is required.

Copper, like chromium, was easily detected in all the samples analyzed. Median concentration in surficial harbor deposits was approximately five times those in shale, and about 20 times those in marine plants (Bowen, 1966). Copper concentrations in the dredged waste disposal area and in the sewage sludge areas were distinctly higher than in the continental shelf sediment (Fig. 3-1). The contour line for 50 parts per million (grams per ton) seems to be a useful indicator for the distribution of waste deposits in this region (Fig. 3-3). Two sediment samples from locations well removed from the waste disposal sites had copper concentrations in excess of that value. Thus, despite the relatively high background concentrations for copper in common sediments and sedimentary rocks, it has promise as an indicator for mapping the waste distribution on sandy continental shelf areas around New York Harbor. The relatively high copper concentrations in shale suggests that it may be less useful where wastes are deposited on fine grained materials such as Long Island Sound sediment.

Lead, was easily detected in the waste deposits and in most of the harbor deposits (Fig. 3-1). The lead concentrations in these deposits were 20 times higher than in normal shales and about 50 times greater than the concentration in marine plants. It is also interesting to note that the lead concentrations in sewage sludges and harbor deposits are not significantly different. The detection limit for lead in the samples was about 100 parts per million (Fig. 3-4). This itself provides a useful index for the presence of waste deposits. If lead is detectable in the sands, it is very likely it comes from waste solids.

Silver, like lead, is easily detected in the waste deposits and in sewage sludges, but was found to be detectable in only two samples of continental shelf sediment (Fig. 3-5). Silver in the deposits was more useful in marking the boundaries of the dredged waste deposits than for the sewage sludge deposits where it was detected only in the immediate vicinity of the designated disposal site.

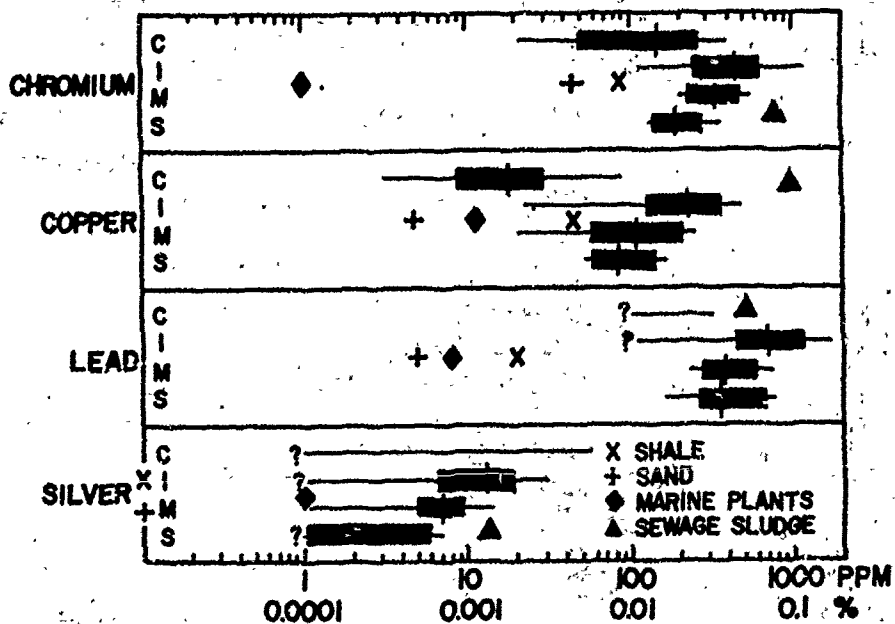


Fig. 3-1. Median concentration value (indicated by vertical line) range, and limits for 70 percent of samples analyzed (shown by heavy bar) for surficial samples in New York Harbor and New York Bight. (C-continent shelf sediment, I-inner harbor deposits, M-deposits near "mud" disposal area, S-deposits near sewage sludge disposal area). Typical concentrations are shown for shales, sands, and marine plants. (Bowen, 1966) and sewage sludges (Gross, 1970b). Question marks indicate the detection limits for the various elements.

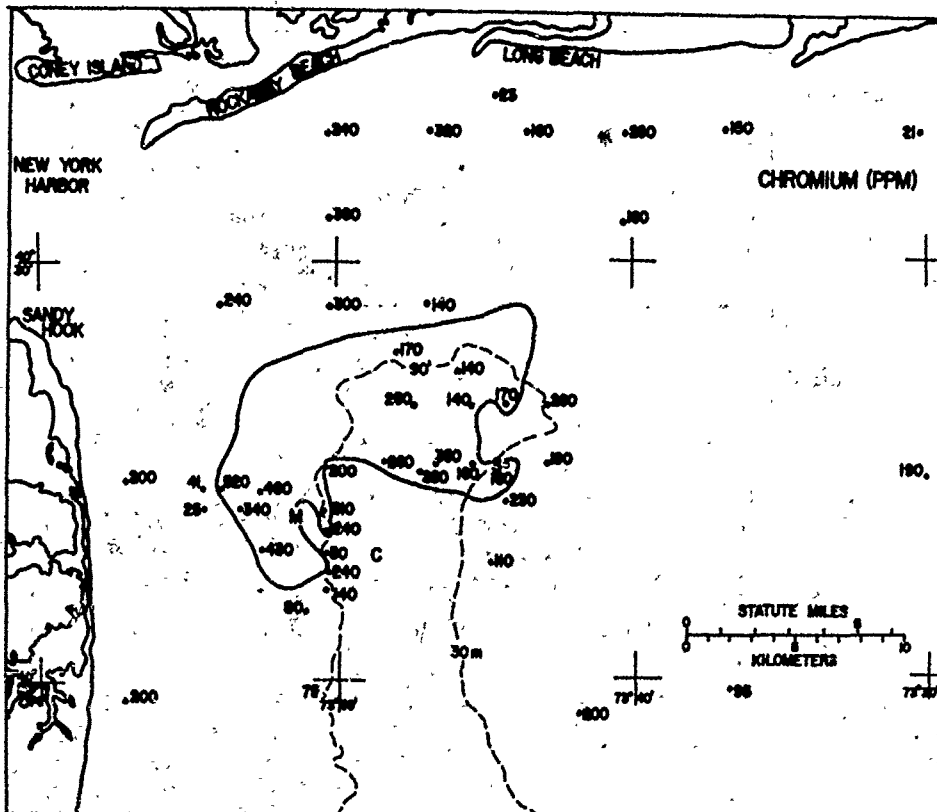


Fig. 3-2. Distribution of total chromium concentrations in surficial sediment and waste deposits in New York Bight. Approximate location of disposal areas are indicated as follows: S-sewage sludge, M-"mud" disposal area, C-"cellar dirt" disposal site. The heavy contour outlines the area containing deposits with more than one percent total carbon.

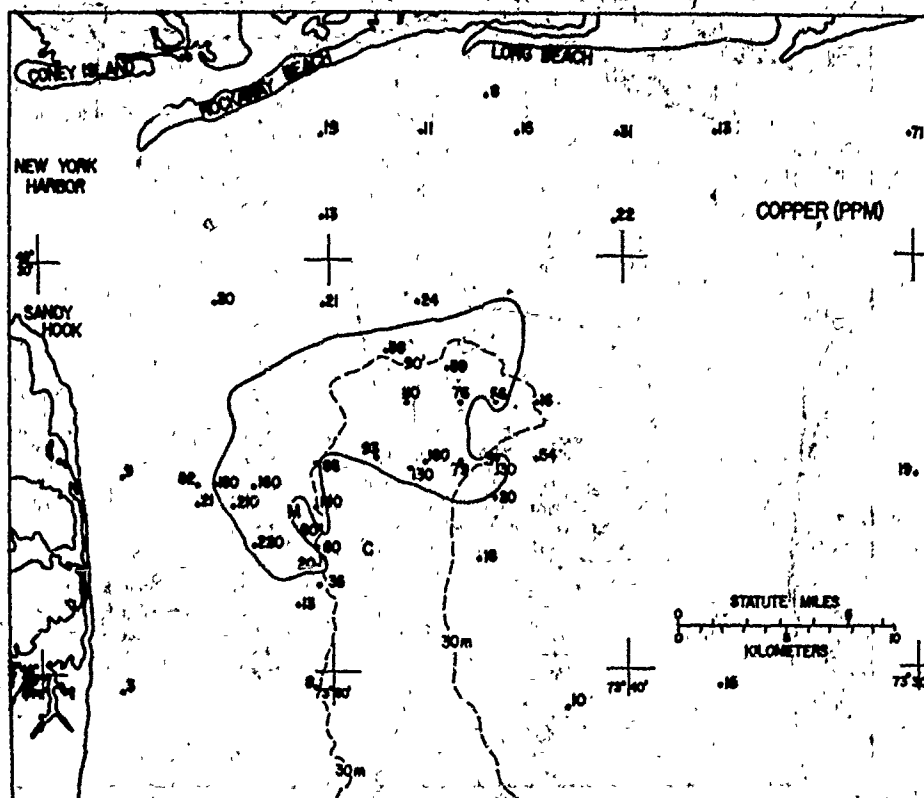


Fig. 3-3. Distribution of total copper concentrations in surficial sediment and waste deposits in the New York Bight. Approximate location of disposal areas and significance of contour indicated in Fig. 3-2.

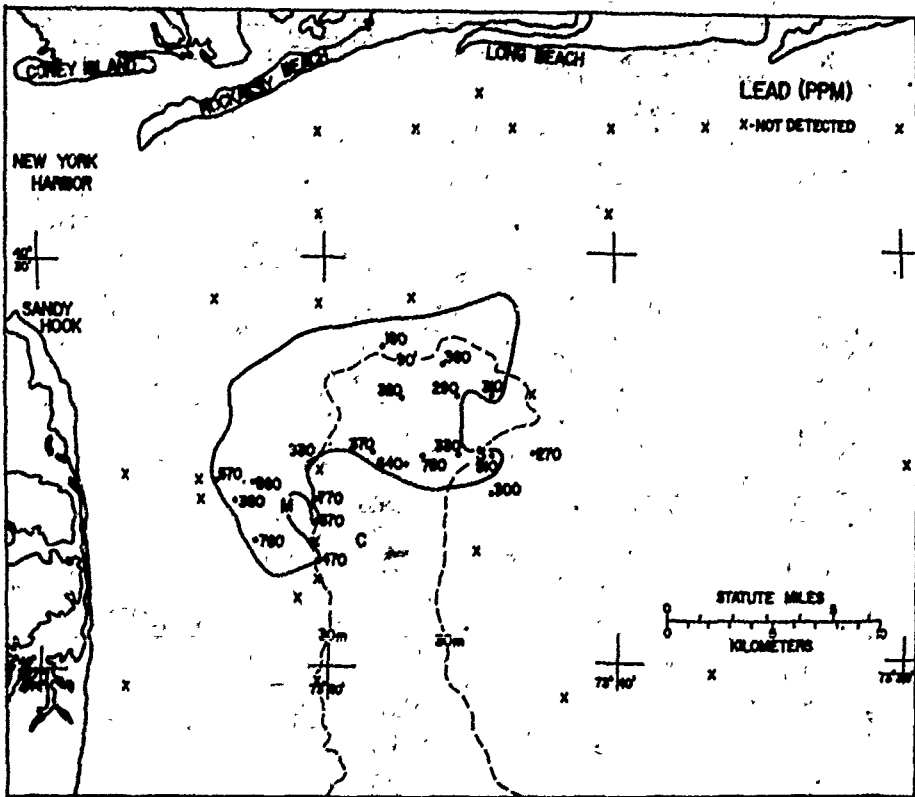


Fig. 3-4. Distribution of total lead concentrations in surficial sediment and waste deposits in the New York Bight. Approximate location of disposal areas and significance of contour indicated in Fig. 3-2.

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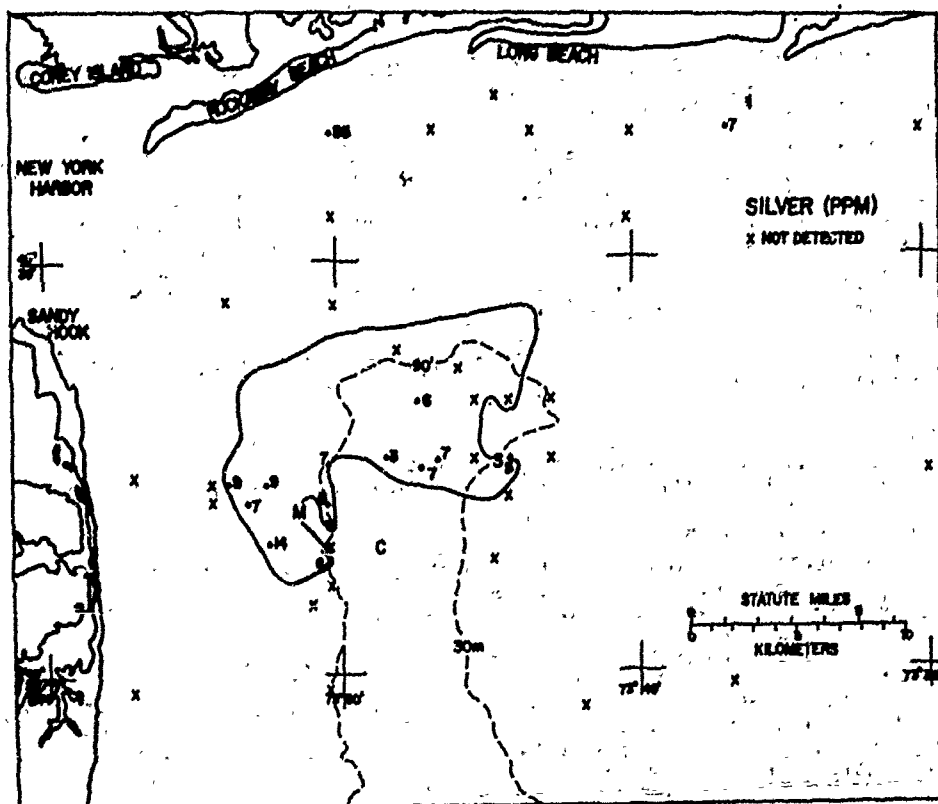


Fig. 3-5. Distribution of total silver concentrations in surficial sediment and waste deposits in the New York Bight. Approximate location of disposal sites and significance of contour discussed in Fig. 3-2.

Chapter 4

Atomic absorption spectrometric analyses of acid-extractable minor elements in wastes and waste deposits

by M. Grant Gross, John A. Black, and James R. Schramel

Hydrochloric acid extracts were made of various wastes and waste deposits and their elemental composition as determined by atomic absorption spectrometry. From the results of the extraction procedures, it is possible to draw some preliminary conclusions about the probable behavior of the various elements in the marine waste deposits. Furthermore, the data provide the basis for more intensive investigations such as using specific elements characteristic of certain types of wastes as tracers to study the distribution of these wastes in the harbor, Long Island Sound, and the New York Bight.

Minor elements (constituting less than 0.1 percent by weight of dry solids) occur in many different forms, including:

Particles:

- Silicate minerals - incorporated in crystal lattice
- Metallic particles - pure metals, alloys, or corrosion products

Coatings and films on grains:

- Chemically precipitated - iron or manganese compounds are common examples of such grain coatings
- Physically incorporated in coating - particles may be occluded in grain coatings
- Biological materials - including wastes and decomposition products

Lacking detailed knowledge about the composition of sewage solids and their mineral composition, it is difficult to develop extraction and analytical procedures that will provide the most useful information about the behavior of wastes discharged into coastal waters.

EXTRACTION TECHNIQUES

The procedure adopted for the study of sewage solids and various waste deposits was extraction by boiling one normal hydrochloric acid. This technique dissolves acid soluble particles and removes acid soluble surface coatings including those ions on the surfaces of silicate mineral grains that are readily displaced by other ions (so-called exchangeable ions). Hydrochloric acid does not readily decompose most silicate grains although use of strong oxidizing acids (such as perchloric acid, sulfuric acid, or nitric acid) was avoided because the wastes and waste deposits are unlikely to be exposed to such highly oxidizing conditions in the ocean or after deposition. Thus, it seemed that hydrochloric acid extraction offered the greatest probability of providing information that could be used to predict the behavior of these wastes in oceanic conditions.

Reagents used during extraction procedure must be considered as sources of contamination. In general, hydrochloric acid is relatively free of contamination, although it may contain trace quantities of B, Ba, K, Na, and Pb. Nitric acid, another extracting agent may contain Al, Ca, Cr, Cu, Fe, Mg, Na, Ni, Pb, and Si (Pinta, 1970, p.31). In these analyses, the hydrochloric acid was analyzed and the results obtained for this blank were subtracted.

In this report, the yield is estimated by comparing the amount of each element extractable by hydrochloric acid with the amount indicated by emission spectrochemical analyses of sewage sludges (Gross, 1970b). Another means of determining total elemental concentrations involves the use of hydrofluoric acid to decompose silicates followed by dissolving the sample in sulfuric or hydrochloric acid. While this extraction technique is likely to dissolve the sample (including silicates), it completely destroys the sample and therefore provides little information about its chemical form.

ANALYTICAL PROCEDURES

Samples were dried in air under infrared lamps. Large organisms (such as snails, crabs) were removed. Each dried sample was then ground in a ceramic vial (Spex Industries) until fine enough to pass through 100-micron-diameter-openings in nylon bolting cloth. Ground samples were then mixed and stored in plastic vials while awaiting analysis (see Gross (1970b) for details). Prior to analysis ground samples were again dried at 110°C and weighed. One gram of dried sample was refluxed in 100 ml boiling 1N HCl for one hour. After cooling to room temperature the extract was analyzed along with standard solutions, a blank, and double distilled water.

A Perkin-Elmer model 290 Atomic Absorption Spectrophotometer was used for the analyses. Instrument settings are given in Table 4-1. A three-slot burner head was used to obtain maximum sensitivity in the analyses.

For each element a standard curve was constructed to determine instrumental readings obtained from analysis of prepared solutions of known elemental concentration. Only the linear portion of the curve was used for the analysis. In addition, a separate curve was constructed to cover concentrations ranging from 0.005 mg/ml to 0.25 mg/ml. Once the general concentration was determined using the wide-range curve, the solution was diluted (if necessary) so that the linear portion of the standard curve was used. Such dilution was necessary for example to determine iron concentrations in Long Island Sound sediment: a dilution of twenty-fold (volume basis) was necessary to obtain a solution of concentration appropriate for analysis in the linear portion of the curve relating concentration to instrument reading.

ATOMIC ABSORPTION SPECTROMETRY

Atomic absorption spectrometry is a sensitive and precise analytical technique for determining elemental concentrations in liquid samples (Ramírez-Muñoz, 1968). In its simplest form, the technique requires a source of radiation, usually a hollow-cathode lamp which produces light of a frequency determined by the metal of which the lamp cathode is made. The liquid sample is dispersed in a flame where the heat decomposes the solution into its component atoms, or molecules. These atoms dispersed in the flame then absorb energy at discrete wavelengths from the light passing through the flame reducing the intensity of the beam as it traverses the beam. A detector measures the intensity of the beam after passing through the flame. By analyzing (under the same conditions) solutions of known composition, it is possible to relate measured beam intensity to elemental concentration in the solution.

Atomic absorption spectrometry is an attractive technique because of its sensitivity and precision. The technique is especially sensitive for such elements as copper, cobalt, and zinc, which occur in industrial wastes in sewage solids, and in various marine waste deposits. (Sensitivity of the technique is defined as that concentration that produced 1 percent absorption). The technique is also precise,

Table 4-1. Instrumental settings for elemental analysis on atomic absorption spectrophotometer (Perkin-Elmer Model 290).

Element	Monochromator Setting	Slit Width (Å) ^o	Minimum Detectable Concentration (ppm)	Relative Standard Deviation (%)
Cu*	280.1	7	0.1	0.50
Ni*	310.4	2	0.1	0.05
Cr*	340.1	2	0.1	0.36
Co*	130.8	2	0.5	0.98
Hg	153.7	7	2.0	0.99
Fe*	144.2	2	0.06	1.75
Cd	109.8	7	0.1	0.06

*Multi-element lamp

generally within 1 percent. Once the instrument is set up, it is relatively easy to analyze a large number of samples for a single element.

Aside from instrumental limitations, atomic absorption spectrometry is affected by interference of the matrix in which the element of interest is dispersed. Two matrix problems are commonly encountered: (1) Inter-element effects results from the presence of different elements originally present in the same sample. (2) Effects resulting from specific properties of the solvent or dispersant. In this project we did not specifically investigate matrix effects.

DISCUSSION OF RESULTS

For five elements (copper, nickel, chromium, manganese, iron) the concentrations of extractable metals correlated well with the total concentrations determined by emission spectrometry. The data for copper (Fig. 4-1) and chromium (Fig. 4-2) are typical. In general, about one percent of the total amount of the element present, as indicated by the emission spectrochemical techniques, was extractable by the hydrochloric acid procedure. Extractable nickel constituted between five and ten percent of the total amount present.

Concentrations of extractable zinc generally correlated well with the apparent total concentrations (Fig. 4-3) indicating extraction efficiencies of between one and five percent. The spread in the data, however, was substantially greater than can be readily explained by the precision of the analytical techniques employed.

Correlation between total and extractable lead concentrations was relatively poor (Fig. 4-4), although the extraction efficiency was generally much higher for lead than for other elements studied, generally greater than 10 percent. No apparent correlation was observable between the total and extractable tin concentrations. Apparent extraction efficiency for tin was generally around one percent.

The high degree of correlation between extractable and total concentrations for copper, chromium, and iron suggests (but does not prove) that these elements are fairly well dispersed throughout the samples analyzed and occur generally in some chemical form such that the relative amount extracted by hydrochloric acid under these circumstances remains nearly constant. The poorer correlation between extractable and total concentrations of nickel, zinc, and manganese indicates that either these elements are more heterogeneously dispersed or that they occur in several forms in the samples so that the extraction was not constant. The general lack of correlation between the total and extractable concentrations of lead and tin cannot be explained. It is interesting to note the high but perhaps variable extraction efficiency for lead.

IMPLICATIONS OF EXTRACTION EXPERIMENTS

Because of the difficulty experienced in extractions of the minor elements by hot hydrochloric acid, it seems unlikely that large amounts of these potentially troublesome minor elements will leach out of the sludge deposits and enter seawater in a soluble form to be carried away and dispersed widely. Most metals, once incorporated in the sewage solids, seem likely to remain there.

Lead is perhaps the most likely to prove troublesome. The extraction experiments showed that it could be recovered from the solids at relatively high, although variable, efficiencies. It should be noted that results of the extractions were highly reproducible. The relative standard deviation was 0.03 percent as determined from 92 analyses.

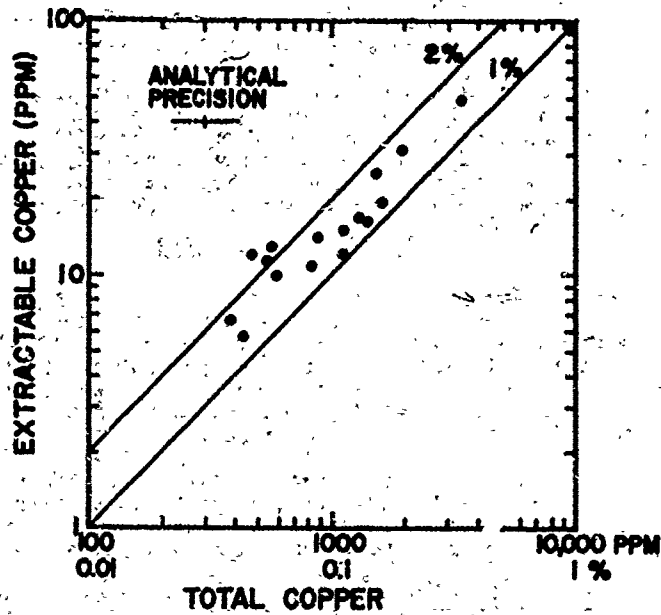


Fig. 4-1. Comparison of total copper concentration in sewage sludges as determined by optical emission spectrometry (Gross, 1970b) and the concentration of hydrochloric-acid extractable copper as determined by atomic absorption spectrometry. Note that only one to two percent of the total copper concentration indicated by optical emission spectrometry was extractable by the acid. An estimate of the analytical precision of the two techniques is indicated.

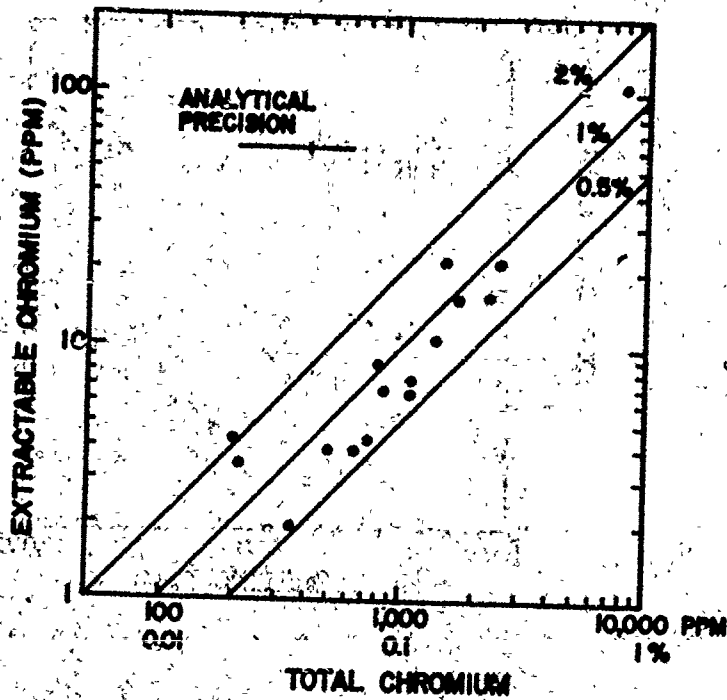


Fig. 4-2. Comparison of total chromium concentration in sewage sludges as determined by optical emission spectrometry (Gross, 1970b) and the concentration of hydrochloric-acid extractable chromium as determined by atomic absorption spectrometry. A parent extraction efficiency of the hydrochloric-acid treatment was typically around one percent, ranging from 0.5 percent to 2 percent.

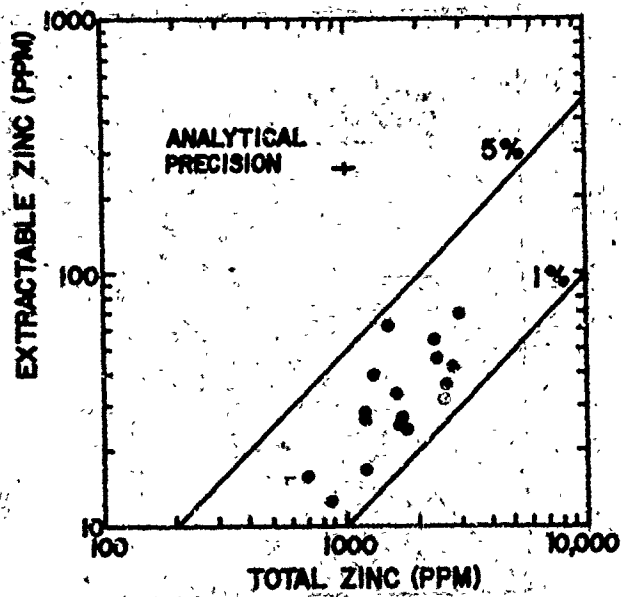


Fig. 4-3. Comparison of total zinc concentration in sewage sludges as determined by optical emission spectrometry (Gross, 1970b) and the concentration of hydrochloric-acid extractable zinc as determined by atomic absorption spectrometry. Apparent extraction efficiency of the hydrochloric acid treatment was between one and five percent.

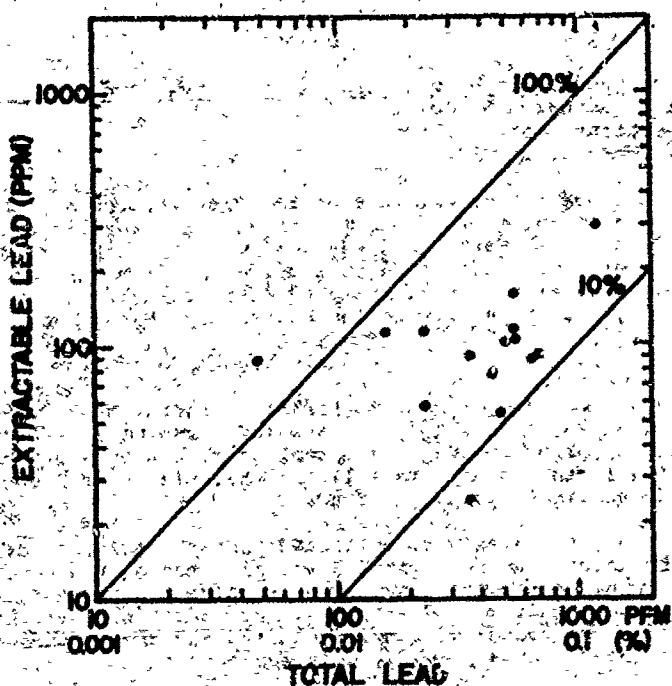


Fig. 4-4. Comparison of total lead concentration in sewage sludges as determined by optical emission spectrometry (Gross, 1970b) and the concentration of hydrochloric-acid extractable zinc as determined by atomic absorption spectrometry. Note that the extraction efficiency of the hydrochloric acid treatment ranged from 10 to 100 percent.

Chapter 5

Reconnaissance studies of benthic organisms in New York Harbor and adjacent waters
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A reconnaissance survey was made of the distribution and abundance of common benthic macroscopic and microscopic marine and brackish water invertebrates (Table 5-1) in New York Harbor and adjacent waters, emphasizing foraminifera and ostracods. Samples were collected during 1969-70 from the harbor area by the Marine Sciences Research Center. Samples from near the harbor mouth (Fig. 5-1) were supplied by the Sandy Hook Marine Laboratory, Sandy Hook, New Jersey.

Studies in this area have previously been made of microscopic bottom-dwelling organisms (microbenthos). McCrone and Schafer (1966) studied sedimentary environments and distributions of benthic foraminifera in the Hudson River beyond the limits of this survey. Shupek (1934) studied foraminiferal faunas in Jamaica Bay and the Lower Bay prior to the development of rose bengal stains (Walton, 1952) for identifying living forms. This limits the utility of Shupek's data which could not differentiate living and dead.

In this study, samples were collected from channels, sandy bottom, mud bottoms in the harbor and from waste disposal sites on the continental shelf (Fig. 5-1). Owing to the large number of samples studied and the limited time available, only foraminifera and ostracods were identified at the generic or specific level. The volume of samples studied and the methods of determining abundances for many groups provides only approximations of abundances.

METHODS AND PROCEDURES

A Shipek sampler (Shipek, 1965) was used to obtain sediment samples. Approximately two to three centimeters of the relatively undisturbed surficial layers were scraped off and preserved by freezing. Living organisms in the sample when collected were noted on field data sheets.

After thawing, samples were mixed to insure homogeneity. Except in those few cases of small sample size, 25 cubic centimeters of wet sediment was analyzed. In most cases 5 to 10 cubic centimeters of sediments is sufficient to determine the distribution and abundance of living foraminifera, but due to the rarity of living foraminifera, a larger sample volume was chosen to provide reasonable assurances of the presence or absence of this group. Ostracods are usually less abundant than foraminifera so that a sample volume of 25 cubic centimeters provided an adequate estimate of their abundance. The sample volume was also adequate for identification of nematodes, capitellid worms, and small arthropods.

Wet samples were placed in a beaker containing 70 percent ethanol to preserve organic remains and to destroy any pathogenic organisms in the sediment. Samples were then washed through a set of sieves (mesh openings 149 microns and 74 microns) to separate different size fractions of sediment and to remove silts and clays. Each fraction (including materials less than 74 microns) was preserved in ethanol. Only the material larger than 149 microns was examined in this study.

At this point many samples were small enough to be examined without further concentration. Where the volume of greater than 149 micron material was large, organisms were concentrated by means of multiple immersion in and decantings from an aqueous calcium chloride solution (Density 1.2 grams per cubic centimeter). This method concentrates small low-density organisms such as foraminifera and ostracods.

TABLE 5-1

CHARACTERISTIC AND POLLUTION TOLERANCE OF ORGANISMS SURVEYED

Organism	Characteristics (or common name)	Apparent Pollution-Tolerance
Foraminifera	Microscopic single-celled protozoans with shell of calcite or cemented sedimentary material (arenaceous)	Low to moderate
Ostracods	Microscopic, bivalved, arthropods often referred to as "mussel shrimp"	Low
Nematodes	Microscopic thread-like worms common in marine environments	High
Capitellids	Aquatic worms, often referred to as sludge-worms	High
Arthropods	Small shrimp-like, free-living animals	Moderate
Decapods	Crabs	Low
Pelecypods	Clams	Low to moderate
Gastropods	Snails	Low to moderate
Bryozoans	Microscopic, colonial animals often referred to as "Moss Animals"	Low
Barnacles	Encrusting marine arthropods	Low to moderate
Annelids	Worms including earth-worms and marine clam-worms	Moderate to high

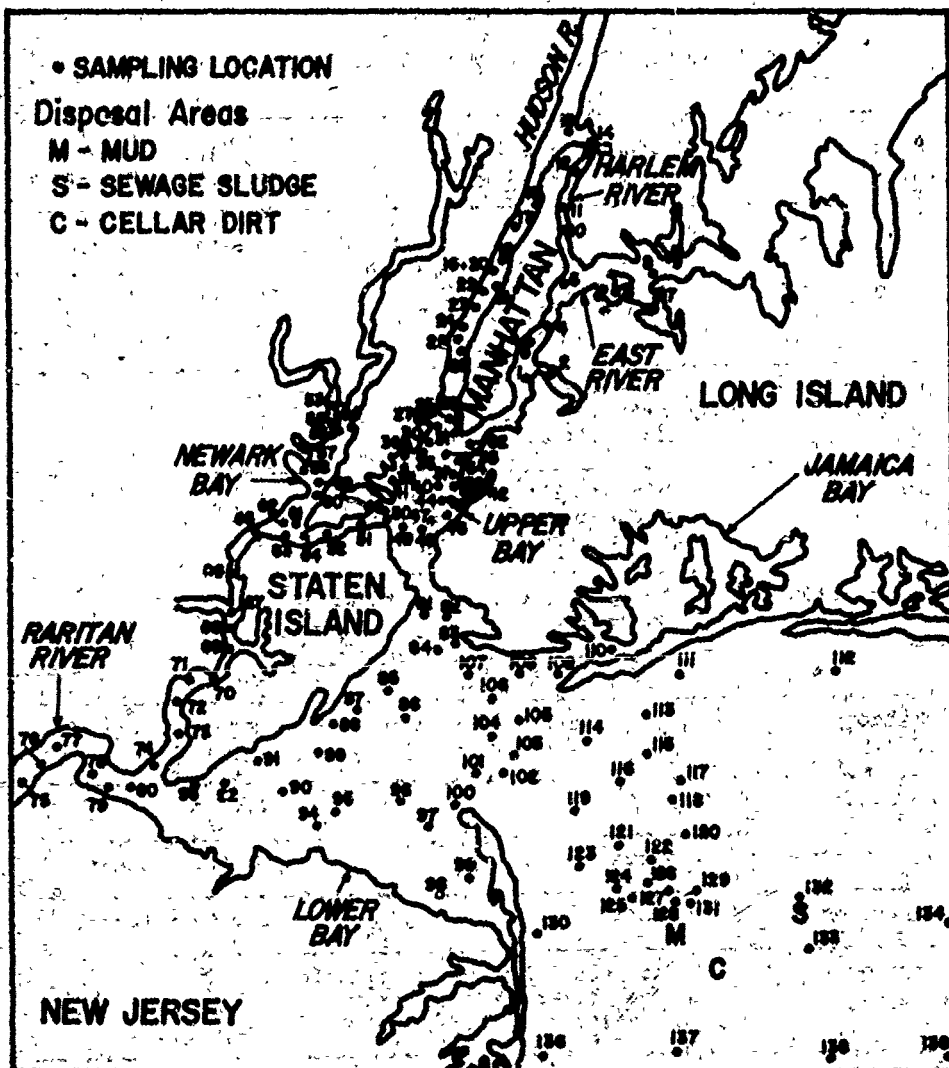


Fig. 5-1. Sample locations and waste disposal areas. (M-"mud" disposal; S-sewage sludge disposal; C-cellar dirt)

The samples were treated with rose bengal stain (Walton, 1952) which imparts a reddish color to the protoplasm of living or recently dead organisms. Long-dead organisms are unaffected. After 30 to 60 minutes in the staining solution, samples were washed on the 149-micron screen to remove the staining solution and then transferred to ethanol for study.

Samples were examined in ethanol to prevent destruction of soft-bodied organisms such as nematodes, capitellids, and annelids. Taxonomic determination of foraminifera at the species level in closely related species such as the foraminiferan Elphidium, however, is more difficult when immersed in liquid than in dried samples.

Though not identified, specimens of rare organisms such as small arthropods, decapods, pelecypods, gastropods, etc. were isolated and preserved in ethanol for possible future study. Representative specimens of commonly occurring benthic organisms such as nematodes and capitellids were also preserved. In addition, materials larger than 149 microns, including organisms not studied were preserved and retained.

Abundances of organisms were determined by the following methods. Live specimens of foraminifera, ostracods, unidentified small arthropods, decapods, pelecypods, gastropods, bryozoan colonies, barnacles and annelid worms were counted and recorded. Abundances of nematodes and capitellid worms were estimated and recorded (Table 5-2) using the following notation:

Number of Individuals per 25 cc	Notation
1 - 10	Rare
10 - 20	Few
20 - 50	Numerous
50 - 100	Common
100	Abundant

In addition to organisms observed in the 25 cubic centimeter sample, field data sheets were reviewed and any larger organisms such as pelecypods, annelid worms and decapods not likely to be found in a 25 cubic centimeter sample were recorded. Abundances for the few samples of less than 25 cubic centimeters are standardized to 25 cubic centimeters. Percentages of sand and silt clay, and total carbon concentrations are recorded for each sample on this table.

DISTRIBUTION AND ABUNDANCE OF ORGANISMS

Foraminifera: No living foraminifera were found in sediment from Newark Bay and the East, Hudson, Harlem and Raritan Rivers. Living foraminifera were present in only three samples from Upper Bay (samples #33, 48, 49) and one in the lower reaches of Arthur Kill (#74) (Fig. 5-1,2; Table 5-2). In the entire harbor only five living foraminifera were found in 80 sediment samples (2,000 cubic centimeters) examined. Living foraminifera occurred often in abundance, in Lower Bay and offshore sediments (Fig. 5-1,3,4; Table 5-2) including those taken near designated waste disposal areas.

Only the foraminifera Elphidium and Ammonia beccarii were found alive in sediments from Lower Bay, Upper Bay, and Arthur Kill River. Species of Elphidium

Table 5-2. Sediment type, total carbon, and abundances of living organisms per 25 cubic centimeter, sample (wet volume) from New York Harbor and adjacent waters.

No.	Sediment Composition			Foraminifera	Ostracoda	Nematodes	Capitellids	Arthropods*	Decapods	Pelecypods	Gastropods	Bryozoa	Barnacles	Annelids†
	Sand %	Silt-Clay %	Total Carbon %											
East River														
1	38.0	62.0	13.32	X	X	R	X	X	X	X	X	X	X	R
2	35.0	65.0	11.04	X	X	X	X	X	X	X	X	X	X	X
3	96.0	4.0	1.28	X	X	A	H	M	X	X	X	X	F	R
4	100	0	nd	X	X	R	R	A	X	X	X	X	M	R
5	nd	nd	7.56	X	X	R	R	X	X	X	X	X	X	R
6	95.00	5.00	1.82	X	X	A	M	R	X	(R)	X	X	X	X
7	3.00	97.00	6.27	X	X	M	R	R	X	X	X	X	X	X
8	67.00	33.00	10.61	X	X	M	R	R	X	(R)	X	X	X	X
9	4.50	95.50	7.22	X	X	F	X	X	X	X	X	X	X	(R)
Harlem River														
10	10.0	90.0	5.24	X	X	F	X	R	X	X	X	X	(R)	X
11	100.0	00.0	nd	X	X	X	X	X	X	X	X	X	X	X
12	10.0	90.0	6.88	X	X	F	X	R	X	X	R	X	R	X
13	nd	nd	nd	X	X	F	X	F	R	R	R	F	F	R
14	6.0	94.0	1.33	X	X	R	X	X	R	X	X	X	R	X
Hudson River														
15	100.0	00.0	nd	X	X	X	N	R	X	X	R	X	X	X
16	3.0	97.0	3.86	X	X	X	N	R	X	X	R	X	X	X
17	40.0	60.0	4.39	X	X	F	X	R	X	R	R	X	X	X
18	00.0	100.0	5.09	X	X	N	X	R	X	X	X	X	X	X
19	5.0	95.0	3.93	X	X	R	X	X	X	X	X	X	X	X
20	nd	nd	nd	X	X	R	X	X	X	X	R	X	X	X
21	3.0	97.0	5.67	X	X	N	X	R	X	X	X	X	X	X
22	10.0	90.0	2.49	X	X	R	X	X	X	X	X	R	X	R
23	nd	nd	nd	X	X	R	X	X	X	X	X	X	X	X
24	00.0	100.0	4.73	X	X	R	R	X	X	X	X	X	X	X
25	20.0	80.0	3.59	X	X	F	M	R	X	R	X	X	X	R
26	7.0	93.0	6.11	X	X	X	X	X	X	X	X	X	X	X
27	100.0	00.0	nd	X	X	R	X	X	X	X	X	X	X	X
28	21.0	79.0	4.10	X	X	C	A	X	X	R	X	X	X	R
29	2.0	98.0	5.69	X	X	R	X	X	X	X	X	X	X	X

nd. - no data

X - not observed

R - rare, 1-10 organisms/25 cc

F - few, 10-20

* - excluding ostracods, decapods, and barnacles

† - excluding capitellids

N - numerous, 20-50

C - common, 50-100

A - abundant - 100

(R) - observed during sample collection but not seen in 25 cc sample

Table 5-2. (continued)

No.	Sediment Composition			Foraminifera	Ostracoda	Nematodes	Capitellids	Arthropods*	Decapods	Pelecypods	Gastropods	Bryozoa	Barnacles	Annelids +
	Sand %	Silt-Clay %	Total Carbon %											
Upper Bay														
30	26	74	4.37	X	X	R	R	X	X	X	X	X	X	X
31	31	69	5.43	X	X	C	X	X	X	X	X	X	X	X
32	38	62	4.41	X	X	M	C	R	X	X	X	X	X	R
33	35	65	4.05	R	X	M	X	X	X	X	X	X	X	R
34	100	0	1.02	X	X	A	X	R	X	X	X	X	X	R
35	96	4	.47	X	X	M	C	R	X	X	X	X	X	R
36	92	8	1.02	X	X	R	X	X	X	X	X	X	X	R
37	0	100	6.11	X	X	F	M	X	X	X	X	X	X	R
38	12	88	5.45	X	X	R	X	X	X	X	X	X	X	X
39	13	87	3.22	X	X	R	X	X	X	X	X	X	X	X
40	5	95	6.34	X	X	C	M	R	X	R	X	X	X	R
41	65	35	2.91	X	X	R	X	X	X	X	X	X	X	(R)
42	49	51	8.52	X	X	R	X	X	X	X	X	X	X	X
43	12	88	5.76	X	X	M	C	(R)	(R)	X	X	X	X	F
44	55	95	9.27	X	X	F	C	X	X	X	X	X	X	X
45	27	73	3.03	X	X	C	X	X	X	R	X	X	X	X
46	7	93	6.47	X	X	C	X	X	X	X	X	X	X	X
47	31	69	5.40	X	X	C	X	X	X	X	X	X	X	(R)
48	85	15	.89	R	X	R	X	X	X	X	X	X	X	X
49	75	25	1.70	R	X	R	X	X	X	X	X	X	X	X
50	87	13	1.07	X	X	C	X	X	X	X	X	X	X	X
51	clinker and coal ash		11.50	X	X	X	R	X	X	(R)	X	X	X	X
52	nd	nd	.94	X	X	F	R	X	X	X	X	X	X	X
Newark Bay														
53	16	84	3.86	X	X	R	X	X	X	X	X	X	X	X
54	nd	nd	6.42	X	X	R	X	X	X	X	X	X	X	X
55	6	94	3.91	X	X	R	X	X	X	X	X	X	X	X
56	12	88	4.60	X	X	X	X	X	X	X	X	X	X	X
57	nd	nd	6.20	X	X	R	X	X	X	X	X	X	X	X
58	41	59	2.43	X	X	R	X	R	X	X	X	X	X	X
59	18	82	4.58	X	X	R	X	R	X	X	X	X	X	X
60	18	82	3.73	X	X	R	X	X	X	X	X	X	X	X
61	83	17	2.46	X	X	R	X	R	X	X	X	X	X	R
62	18	82	2.36	X	X	R	X	X	X	X	X	X	X	X
63	19	81	6.57	X	X	X	X	X	X	X	X	X	X	X
64	90	10	1.18	X	X	R	X	X	X	X	X	X	X	X

Table 5-2. (continued)

No.	Sediment Composition			Foraminifera	Ostracoda	Mollusca	Caprellids	Arthropoda*	Decapoda	Pelecypoda	Gastropoda	Bryozoa	Barnacles	Annelids +
	Sand %	Silt-Clay %	Total Carbon %											
Arthur Kill														
65	78	22	5.97	X	X	R	X	X	X	X	X	X	X	X
66	48	52	6.09	X	X	R	X	R	X	X	X	X	X	X
67	3	97	6.33	X	X	X	X	R	X	X	X	X	X	X
68	90	10	2.04	X	X	X	X	X	X	X	X	X	X	X
69	79	21	4.17	X	X	X	X	X	X	X	X	X	X	X
70	61	39	2.57	X	X	R	X	R	X	X	X	X	X	X
71	5	95	5.78	X	X	R	X	X	X	X	X	X	X	X
72	93	7	0.60	X	X	R	X	R	X	X	X	X	X	X
73	5	95	4.73	X	X	R	X	R	X	X	X	X	X	X
74	94	6	5.16	R	X	R	X	R	X	X	X	X	X	X
Raritan River														
75	4	96	5.59	X	X	X	X	X	X	X	X	X	X	X
76	nd	nd	5.37	X	X	R	X	F	X	X	X	X	X	R
77	91	9	4.55	X	X	R	X	R	X	X	X	X	X	X
78	22	78	4.31	X	X	F	X	X	X	X	X	X	X	X
79	4	96	4.30	X	X	H	X	F	X	X	X	X	X	X
80†	nd	nd	4.40	X	X	X	X	X	X	X	X	X	X	X
Lower Bay														
81	96	4	0.87	R	X	A	X	R	X	R	(R)	X	X	X
82	70	30	1.26	R	X	A	X	R	X	R	X	X	X	X
83	nd	nd	8.16	X	X	C	X	X	X	R	X	X	X	X
84	100	0	0.26	R	X	X	X	X	X	X	X	X	X	X
85	5	95	5.88	R	X	F	X	F	X	R	X	X	X	X
86	94	6	0.99	C	X	M	X	R	X	R	X	X	X	X
87	81	19	4.28	A	X	C	X	F	X	X	X	X	X	X
88	100	0	nd	C	X	C	X	(R)	X	X	(R)	X	X	X
89	97	3	nd	M	X	C	X	R	X	X	(R)	X	X	X
90	6	94	nd	C	X	R	X	R	X	R	X	X	X	X
91	39	61	nd	A	X	M	X	C	X	X	(R)	X	X	X
92	8	92	nd	F	X	N	X	X	X	X	X	X	X	X
93	1	99	nd	X	X	N	F	X	X	X	X	X	X	X
94	31	69	nd	C	X	C	X	C	X	X	X	X	X	X
95	nd	nd	nd	M	X	F	X	M	X	X	(R)	X	X	X
96	80	20	nd	C	X	A	X	X	X	X	X	X	X	X
97	97	3	nd	X	X	F	X	X	X	X	X	X	X	X

† primarily silt clay

‡ Mainly dead *Mytilus*, 1 alive

Table 5-2. (continued)

No.	Sediment Composition			Foraminifera	Ostracoda	Mollusca	Caprellids	Arthropods*	Decapoda	Pelecypods	Gastropods	Bryozoa	Barnacles	Annelids†	
	Sand %	Silt-Clay %	Total Carbon %												
Lower Bay															
98	0	100	nd	C	X	N	X	R	X	X	X	(R)	X	X	
99	nd	nd	nd	F	X	A	X	R	X	(R)	(R)	X	X	(R)	
100	100	0	nd	X	X	F	X	C	X	X	X	X	X	X	
101	100	0	nd	X	X	F	X	X	(R)	X	X	X	X	X	
102	100	0	nd	X	X	F	X	R	X	X	X	X	X	X	
103	100	0	nd	X	X	F	X	R	X	X	X	X	X	X	
104	97.5	2.5	nd	X	X	M	X	X	X	X	X	X	X	X	
105	100	0	nd	X	X	F	X	X	X	X	X	X	X	X	
106	100	0	nd	X	X	R	X	X	X	X	X	X	X	X	
107	98	2	0.30	X	X	X	X	X	X	X	X	X	X	X	
108	100	0	0.11	X	X	X	X	X	X	X	X	X	X	X	
109	97	3	3.10	X	X	M	X	X	X	X	X	X	X	X	
110	100	0	nd	R	X	C	X	R	X	R	X	X	X	X	
Continental Shelf															
111	nd	nd	.57	R	R	X	X	X	X	R	X	X	X	X	
112	nd	nd	.23	N	X	X	X	R	X	R	X	X	X	X	
113	100	0	.16	X	R	N	X	X	X	R	X	X	X	X	
114	100	0	.22	X	X	F	X	X	X	X	X	X	X	X	
115	100	0	2.66	F	X	M	X	X	X	R	X	X	X	X	
116	100	0	2.55	X	X	X	X	(R)	X	X	X	X	X	X	
117	100	0	.91	F	X	C	X	R	X	R	X	X	X	(R)	
118	nd	nd	.78	R	R	X	X	X	X	R	X	X	X	X	
119	100	0	.10	R	X	X	X	X	X	X	X	X	X	X	
120	99	1	1.73	F	X	C	X	R	X	X	X	X	X	X	
121	98	2	.36	F	X	A	X	R	X	F	X	X	X	X	
122	57	43	2.64	F	X	N	X	R	X	(R)	X	X	X	X	
123	100	0	.40	X	X	X	X	X	X	X	X	X	X	R	
124	56	44	3.31	A	X	A	X	F	X	R	X	X	X	R	
125	96	4	1.28	M	X	C	X	F	X	(R)	(R)	X	X	(R)	
126	100	0	1.34	X	X	F	X	X	X	(R)	(R)	X	X	X	
127	100	0	1.20	R	X	N	X	F	X	(R)	(R)	X	X	(R)	
128	89	11	9.61	N	X	C	X	R	(R)	R	X	X	X	(R)	
129	61	39	2.80	C	X	A	F	R	X	R	X	X	X	(R)	
130	nd	nd	.12 or .15	X	R	X	X	X	X	X	X	X	X	X	
131	nd	nd	1.00	A	M	X	X	R	X	R	X	R	X	R	

Table 5-2. (continued)

No.	Sediment Composition			Foraminifera	Ostracoda	Molluscs	Caprellids	Arthropods *	Decapods	Pelecypods	Gastropods	Bryozoa	Barnacles	Annelids†
	Sand %	Silt-Clay %	Total Carbon %											
Continental Shelf														
132	nd	nd	.47)	.69 or R	R	F	X	R	X	X	X	X	X	X
			.25											
133	nd	nd	.27	A	M	M	X	F	X	M	X	X	X	X
134	nd	nd	.15	C	R	R	X	R	X	R	X	X	X	X
135	nd	nd	.07	M	X	R	X	X	X	M	X	X	X	X
136	nd	nd	.39	M	X	X	X	R	X	R	X	X	X	X
137	nd	nd	.08	A	R	X	X	R	X	F	X	X	X	X
138	nd	nd	.28	M	R	C	X	R	X	X	X	X	X	X
139	nd	nd	.10	A	R	R	X	X	X	R	X	X	X	X

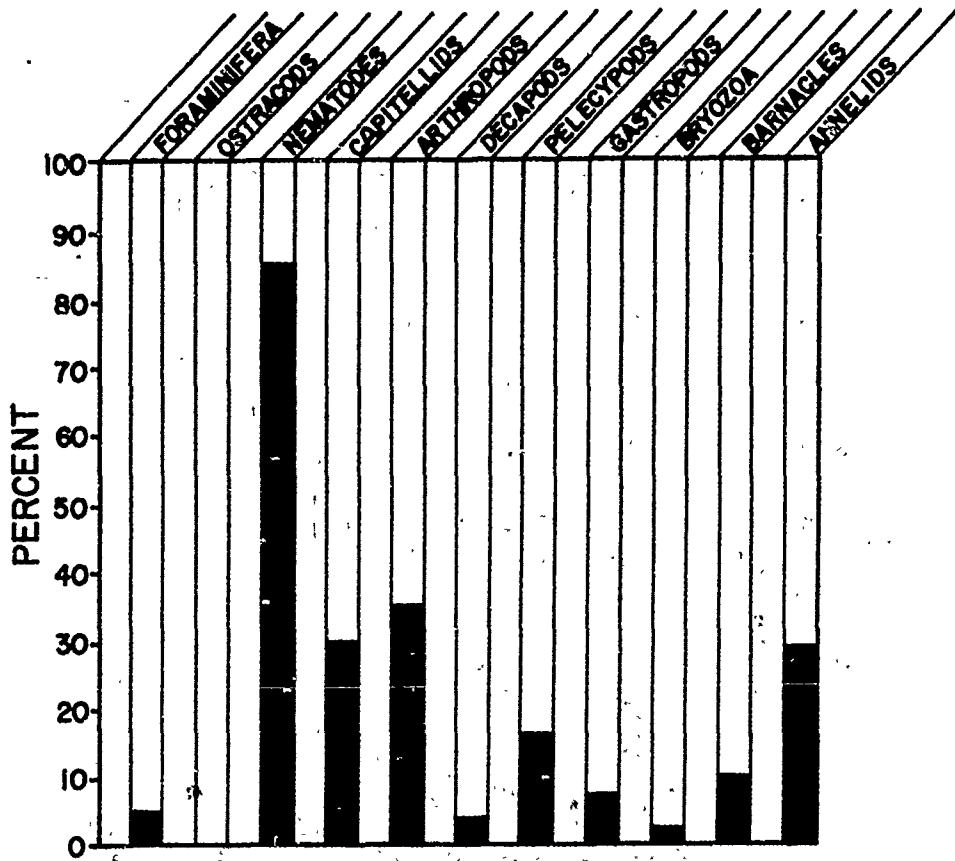


Fig. 5-2. Relative abundance of organisms in sediment samples from Newark Bay, Upper Bay, East, Harlem, Hudson, Arthur Kill and Raritan Rivers.

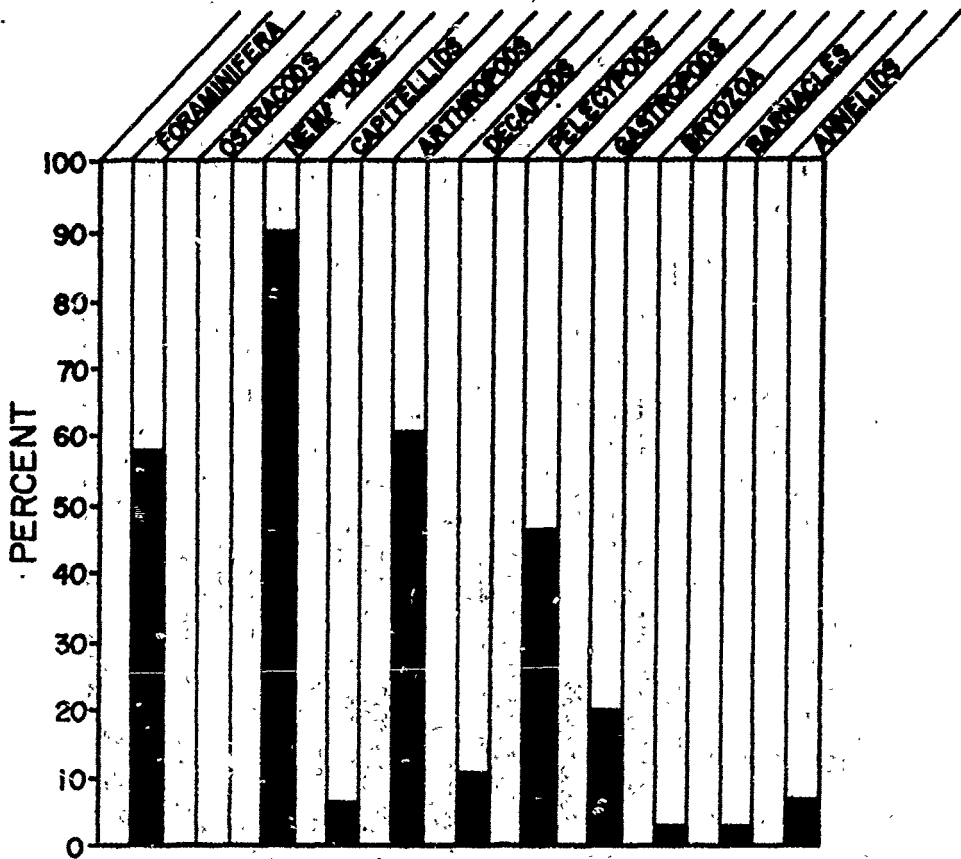


Fig. 5-3. Relative abundance of organisms in sediment samples from Lower Bay

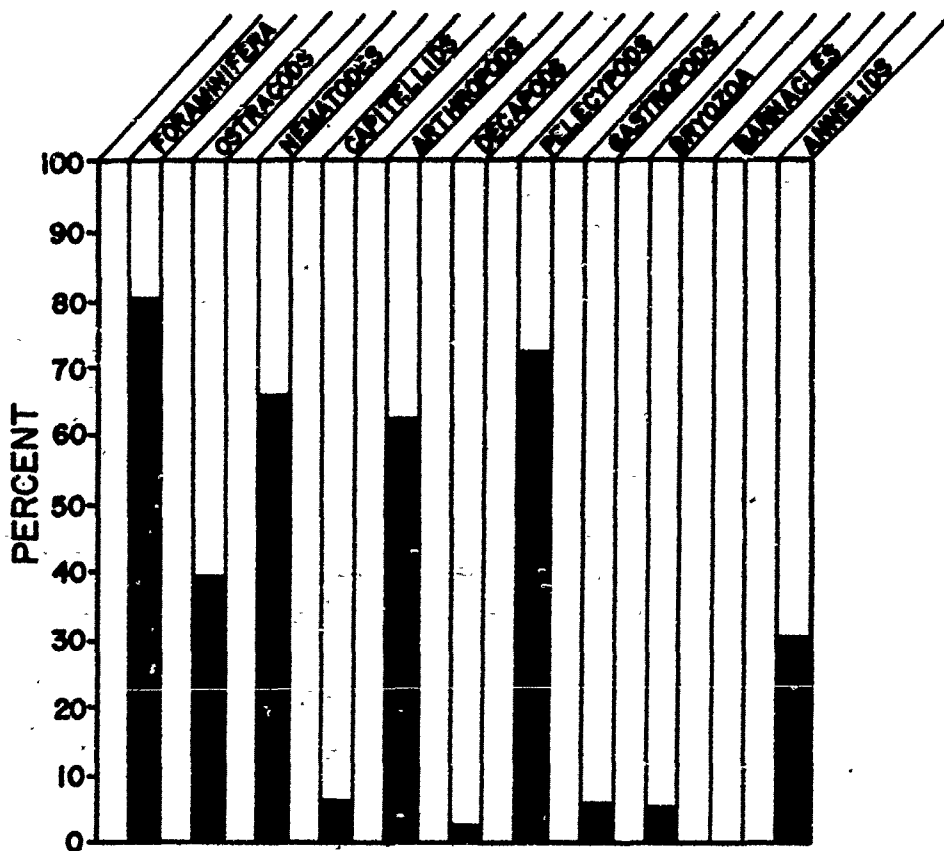


Fig 5-4. Relative abundance of organisms in sediment samples from the continental shelf area near the entrance to New York Harbor.

are morphologically similar making specific identification difficult, especially in liquid media. Nonetheless, nearly all specimens examined appeared to be E. clavatum. The remaining specimens were called Elphidium sp., probably two or three morphologically similar, rare species.

Foraminifera in near-shore sediment deposits included Elphidium clavatum, Elphidium sp., Monionella atlantica, Quinqueloculina seminulum, Pseudopolymorphina novaeangliae, Ammonia cf. fluvialis, Trochammina scutata, Protonina atlantica, and Hyperella advena. Occurrence and abundance of these species was quite variable.

It is noteworthy that in samples 128, 129, and 131, near the mud and "man-stone" disposal site, and sample 133, near the sewage-sludge disposal site, benthic foraminifera were numerous to abundant. In these samples E. clavatum comprised 90-95 percent of the living population of foraminifera. Sample 132, taken near the margin of the sewage sludge disposal site possessed a single living specimen of Monionella atlantica. Several dead specimens of E. clavatum and one dead Q. seminulum were also found. In samples 138 and 139, near the waste chemical disposal site, E. clavatum dominated the numerous to abundant foraminiferal population. Arenaceous forms, however, such Trochammina and Protonina also occurred here in greater abundance than elsewhere.

The majority of living foraminifera (approximately 95 percent) found in Lower Bay sediments were E. clavatum. No living specimens of Q. seminulum were found but several dead specimens were present in many samples from Lower Bay. Many dead specimens of A. beccarii were found but living specimens were very rare.

Of greater interest are the total foraminifera populations in the Upper Bay. One small, possibly juvenile from E. clavatum occurred in sample 33, two specimens of E. clavatum occurred in sample 48, and one specimen of A. beccarii in sample 49. On the west side of the bay, however, large numbers of dead foraminifera were found in several samples. For example, sample 49 contained approximately 150 specimens of E. clavatum and A. beccarii and one Q. seminulum; sample 50, 3 E. clavatum; sample 41, approximately 400 specimens, most of which were apparently juvenile E. clavatum; sample 38, 13 E. clavatum; sample 36, 90 E. clavatum; and sample 33 contained 75 E. clavatum. On the east side of the bay sample 48 contained 300 specimens of E. clavatum, most of which were apparently juveniles, and one Q. seminulum; sample 47 contained 15 E. clavatum and one Puccella frigida which is common in Long Island Sound (Buzas, 1965) but not observed in any other sample in this study, and two Monionella atlantica, observed in this study only in few continental shelf samples. A few E. clavatum and A. beccarii were found in sample 44 and 46.

In the area of the main ship channels in Lower Bay (between Sandy Hook and the Verrazano Narrows, samples 81 - 84, 100 - 108, only five living foraminifera were found. These occurred in samples 81, 82, and 84. Large numbers of dead E. clavatum were found in this area. A few specimens of dead M. atlantica and Q. seminulum were also present. Some samples were also devoid of either living or dead foraminifera.

Foraminiferal assemblages in the Narrows and the Upper Bay are anomalous. The few living specimens found may not actually live in the area. Even the presence of an indigenous population could not account for the abundance of dead specimens found in the samples unless no sediment is deposited in these areas, with only foraminifera shells accumulating there. Furthermore, dead juvenile organisms were unusually abundant as well as dead specimens of species found in the living state only on the continental shelf. Additionally, many of the specimens, both juvenile and adult were thoroughly decomposed although still recognizable. It is possible that near-bottom currents may transport both living

and dead foraminifera into this region from other areas. Once entering the area the foraminifera die and their tests undergo rapid chemical decomposition.

Ostracods: Living ostracods were found only in the continental shelf samples (Fig. 5-1,4; Table 5-2). Species of Lusitanella, Neocytherideis, Actinocytheris, Eucythere, Cytheretta, Muellera, Cuscutanidea, Semicytherura, and Cytheromorpha occurred in variable abundances in several samples. As with the foraminifera in this area, though the ostracods attain expectable population levels in many samples, the lack of an adequate number of samples precludes effective analysis of their distribution and abundances. It is noteworthy, however, that living ostracods occur in samples (#131 - 133, 137 - 139) near waste disposal areas (Table 5-2; Fig. 5-1).

No living ostracods were found in harbor sediments. Several intact carapaces and valves of near-shore species were found in nine samples from Lower Bay (Fig. 5-1). On the west side of the Upper Bay (#30, 38, 41) a few valves and intact carapaces of both juvenile and adults were present. Adult and juvenile valves and carapaces were also found on the east side of the Upper Bay in samples 46, 47, and 48 (Fig. 5-1). Sample 48 exhibited an unusually large number of ostracod remains without the presence of a single living form. Thirty intact adult carapaces of Lusitanella were found. Chitin, coating many of the carapaces, was stained red by rose bengal suggesting recent death of the organism. In addition, a large number of valves and carapaces of five other common continental shelf species were found. Kalin (1970) found similar ostracod distributions in south central Long Island Sound (Smithtown Bay). He attributed the occurrence of large numbers of ostracod remains without the presence of living forms to movements of the remains by near-bottom currents.

Nematodes and Capitellid Worms: These two groups of worms are the most commonly occurring and abundant organisms in many sediment samples from Upper and Newark Bays, and the East, Harlem, Hudson, Arthur Kill, and Raritan Rivers (Fig. 5-1,2,5; Table 5-2). Excluding these two groups of worms, 34 of 80 samples in this area were totally devoid of the common benthic invertebrates surveyed. Nematodes occur commonly in many Lower Bay and continental shelf samples (Fig. 5-4,5; Table 5-2) but capitellids occur only in a few samples, two of which (#122, #129) are near waste disposal sites (Fig. 5-1; Table 5-2).

DISCUSSION

The aquatic environment in the area surveyed ranges from the open waters of the continental shelf to the less saline waters in the restricted channels of the Hudson, Harlem, East, Raritan, and Arthur Kill Rivers. Within the group of organisms surveyed, many species are adapted to these variations of the physical environment and would normally be expected to be present. Yet in many areas of New York Harbor the benthic animal communities adapted to these environments are either drastically reduced in abundance or completely absent.

It is not yet possible to document and identify the specific environmental parameters responsible for the observed changes of the benthic animal communities in the New York Harbor area. There can be little doubt however, that these changes are the result of human activity. For example, frequent dredging of channels affords little opportunity for population of attached bottom dwelling animals to establish themselves. Bottom sediments in many areas, such as the inner harbor, are soft, fine grained, carbon-rich muds smelling of hydrocarbons with the appearance and consistency of sludges. In some areas of the Lower Bay beds of dead mussels were covered by several centimeters of this sludge-like material.

Comparison of the existing benthic animal communities and the parameters of the physical environment of former times is not possible due to the lack of published information. In this respect the condition of the existing benthic

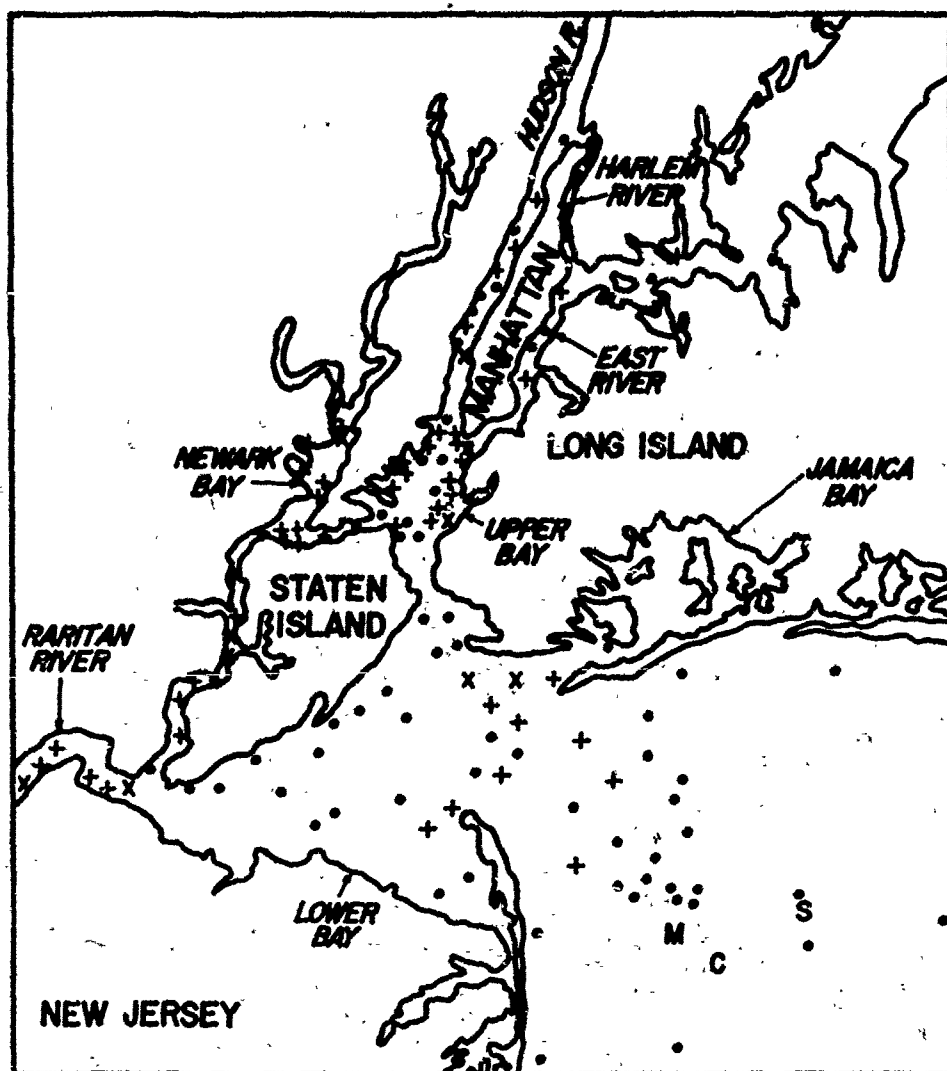


Fig. 5-5. Distribution of benthic communities in New York Harbor and adjacent waters. + Sediments with benthic communities consisting only of nematodes, capitellid worms and occasional arthropod or annelid worms. x Stations devoid of all benthic organisms included in this survey. • Sediment containing a more diverse benthic community.

animal communities can only be compared to those which should theoretically exist in comparable unpolluted areas. For example, ostracods normally occur in all aquatic environments but are totally absent in the Inner Harbor and Lower Bay regions. Their absence provides a relative measure of the modification of the benthic animal community.

On the basis of the distribution and abundance of the organisms surveyed, the New York Harbor region may be subdivided into three areas which relatively reflect the severity of the pollution (Fig. 5-6).

Upper Bay, Newark Bay, Arthur Kill, East, Harlem, Hudson and Raritan Rivers: Nematodes and capitellids constitute the major portion of the benthic community. Living foraminifera were rare. No living ostracods were found. Bryozoan colonies were found in only two samples. Living decapods or crabs occurred in only four samples; two of these were in the uppermost reaches of the Harlem River. Small unidentified arthropods, excluding ostracods, barnacles, and decapods, though found in many samples were rare. Pelecypods, gastropods and barnacles were found in only a few samples. Annelid worms, excluding capitellids, occurred in several areas of the East River and Upper Bay but were found less frequently elsewhere.

Except for a small area in the uppermost portion of the Harlem River, which probably receives relatively less polluted waters from the northern portions of the Hudson River, the benthic communities are drastically reduced or lacking. Nematodes and capitellid worms dominate the fauna in abundance and frequency of occurrence (Fig. 5-2,5; Table 2). Species of nematodes are adapted to and abound in all terrestrial and aquatic environments. Capitellids are often referred to as "Sludge Worms" because of their ability to survive in carbon-rich soft bottoms. Based on the distribution and abundances of these two groups of pollution-tolerant organisms, about 40 percent of the harbor area would be considered to be severely affected by waste deposits. In some areas even nematodes and capitellids were absent. Apparently they could not survive.

Several species of small unidentified arthropods and annelids (excluding ostracods and capitellids) occurred in low abundances in several samples (Table 5-2). These forms constitute a secondary but minor element of the benthic fauna tolerant of the highly polluted conditions (Table 5-1). Of the 80 samples taken in this area, 53 or about 65 percent supported only nematodes or capitellids, often in great abundance, or nematodes, capitellids and very low abundances of the small unidentified arthropods and annelid worms (Table 5-2).

Newark Bay, the Arthur Kill and Raritan Rivers are essentially devoid of benthic animal life, excluding these four groups of pollution-tolerant organisms which occur in very low abundance, if at all. Large segments of the Upper Bay, and the Harlem, East and Hudson Rivers closely approach this condition.

Lower Bay: Though affected in some areas, such as Sandy Hook Bay, Lower Bay is not as seriously affected as the inner portion of the harbor. Benthic organisms are more abundant and diverse in Lower Bay than in the more restricted portions of the harbor complex (Fig. 5-2,3,4; Table 5-2). For example, species of foraminifera, which were exceedingly rare in the harbor complex, occurred in many samples. Often they were present in great abundance. Although no living ostracods were found, many carapaces and valves occurred in the sediments which might indicate their presence in local areas not sampled.

Nematode worms though present do not form the dominant faunal element as in the harbor complex (Fig. 5-2,3,4). Capitellid worms occurred in about 10 percent of the Lower Bay samples as opposed to about 30 percent of the samples in the Inner Harbor. Pelecypods, gastropods, and decapods occurred in about twice as many samples as opposed to the inner harbor. Small arthropods occurred in nearly

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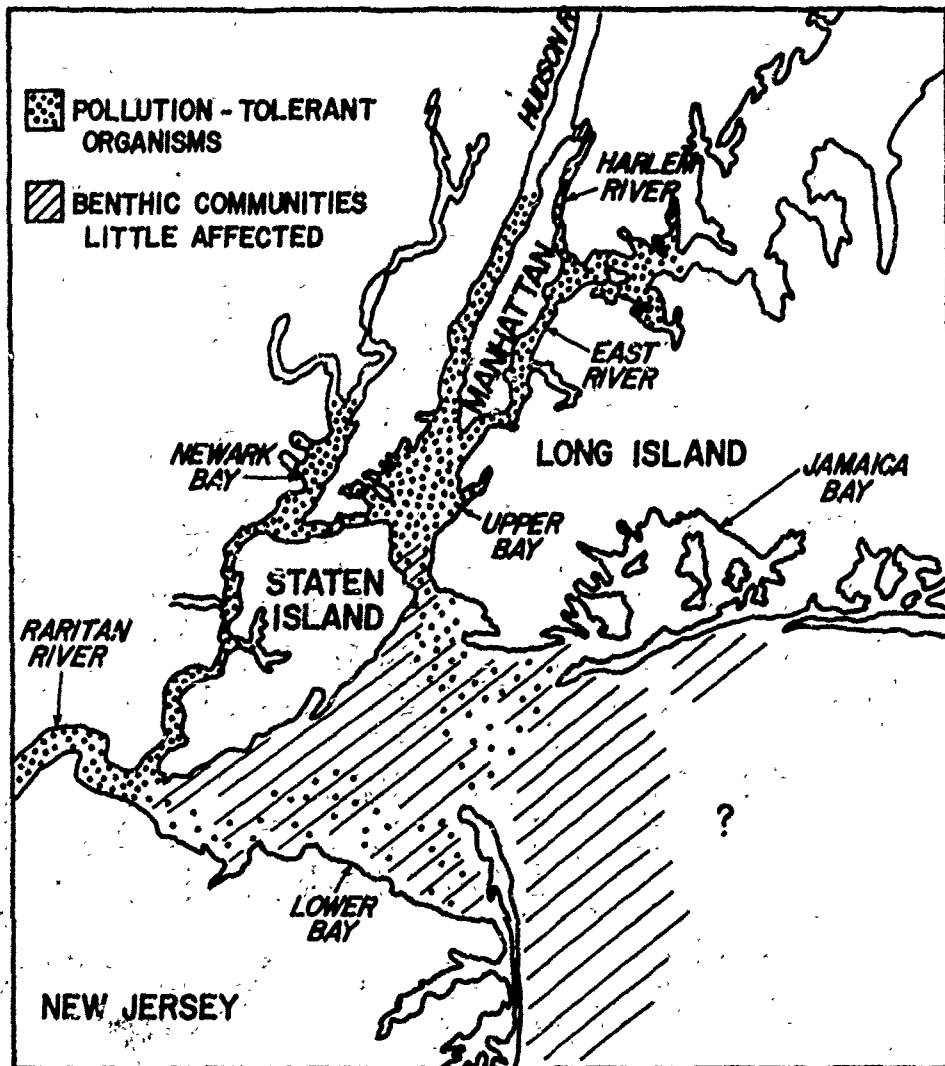


Fig. 5-6. Distribution of affect on the benthic animal life in the New York Harbor and New York Bight.

twice as many samples as opposed to the harbor complex, but annelids were found less frequently.

The more diverse and abundant fauna of the Lower Bay, though locally impoverished, may be the result of the transitional character of the Lower Bay, occurring as it does between the harbor and the offshore coastal ocean. Undredged shoal areas at the harbor mouth had surprisingly few organisms living on the bottom. In part, this may be the result of relatively coarse sediment and exposure to strong wave action over much of the year.

Continental Shelf Area: Benthic organisms in the offshore region were fairly typical of those commonly found on the continental shelf. All groups of organisms surveyed, except the barnacles which prefer shallower waters, were present and often abundant (Table 5-2). Foraminifera, ostracods, nematodes and pelecypods occurred in about 75 percent of the samples. Nematodes, though often numerous, did not dominate the benthic fauna as in the Inner Harbor (Fig. 5-2,4,5). Capitellid worms occurred in only a few samples, two of which (#122, 129) were near waste disposal sites (Fig. 5-1, Table 5-2). Ostracods and foraminifera, the only groups identified to the species level, occurred with diversities and abundances quite typical of continental shelf areas.

Many samples taken near designated waste disposal areas in New York Bight appeared to be more or less typical of the general offshore area (Fig. 5-1; Table 5-2). Based on these few observations, it appears that benthic organisms living on the continental shelf near these waste disposal sites are less affected by waste disposal operations than organisms from the inner harbor complex.

ACKNOWLEDGMENTS

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Chapter 6

Biological effects of waste disposal in Western Long Island Sound: An initial survey
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This study was designed to evaluate possible effects of waste disposal operations in Western Long Island Sound and adjacent waters. The area studied includes waters of Long Island Sound, west of 73°09' W, and adjacent parts of the East River (Fig. 6-1).

Six waste disposal areas with a total area of approximately 30 square kilometers (12 square statute miles) are located within the study area (Fig. 6-1). The three most heavily used sites are located in waters north of Lloyd Neck, approximately 30 meters deep. These sites are used primarily for dumping materials dredged from nearby harbors, and some wastes from the New York Metropolitan area (Gross, 1970). The benthic meiofauna (organisms in the size range 0.5 millimeters to 4 centimeters in length or diameter) was investigated in this preliminary survey.

Because of their small size, large numbers and limited mobility, foraminifera are valuable ecological indicators. Their large numbers makes possible statistically significant studies on the community level using relatively small sediment samples. In most sediment deposits foraminiferal skeletons resist decay for long periods, providing an opportunity to compare changes in relative abundance through time. Ecology and distribution of benthonic foraminifera and ostracoda in Long Island Sound are well documented (Parker, 1952; Buzas, 1965; Schafer, 1968; Kalin, 1970 a,b).

PREVIOUS STUDIES

Shupak (1934) studied foraminifera from six sediment samples taken from New York Harbor and found species of the genus *Elphidium* to be the most common. Parker (1952) listed 36 species from Long Island Sound, of which seven were found consistently throughout the area studied. McCrone and others (1961) in a preliminary survey of the sediments and fauna of Long Island Sound found 22 species of foraminifera. In a quantitative study of benthic foraminifera of Long Island Sound, Buzas (1965) noted an increase in the number of foraminiferal species from west to east and attributed this to the more oceanic conditions in eastern portions of the Sound. He also found less variation in the number of foraminiferal species between stations in the central portions of the Sound.

Schafer (1968) concluded that the concentrations of phosphates and nitrates in bottom waters and coliform bacteria in the surface water increased measurably toward the western part of the Sound. He associated the observed decrease in the number of foraminiferal species with the "increased industrial pollution in the extreme western part of Long Island Sound".

SAMPLING AND ANALYTICAL METHODS

A total of 102 samples and short cores were obtained from 47 locations, samples from R. V. MICMAC during June 1970. At each sample location, depth, sediment color, sediment temperature, grain size classification, presence or absence of H₂S and relative abundance of macro-organisms were recorded.

Sediment samples were collected using a Shipek sampler (Shipek, 1965). Using a short length of plastic core liner (3.5 centimeters in diameter), paired subsamples were punched out of the relatively undisturbed sediment in the Shipek sample bucket. The top 2 centimeters of the sediment sample were extruded into a labeled plastic container to which was added a measured volume of 70 percent ethyl alcohol and rose bengal stain (Walton, 1962). Using similar methods, samples were

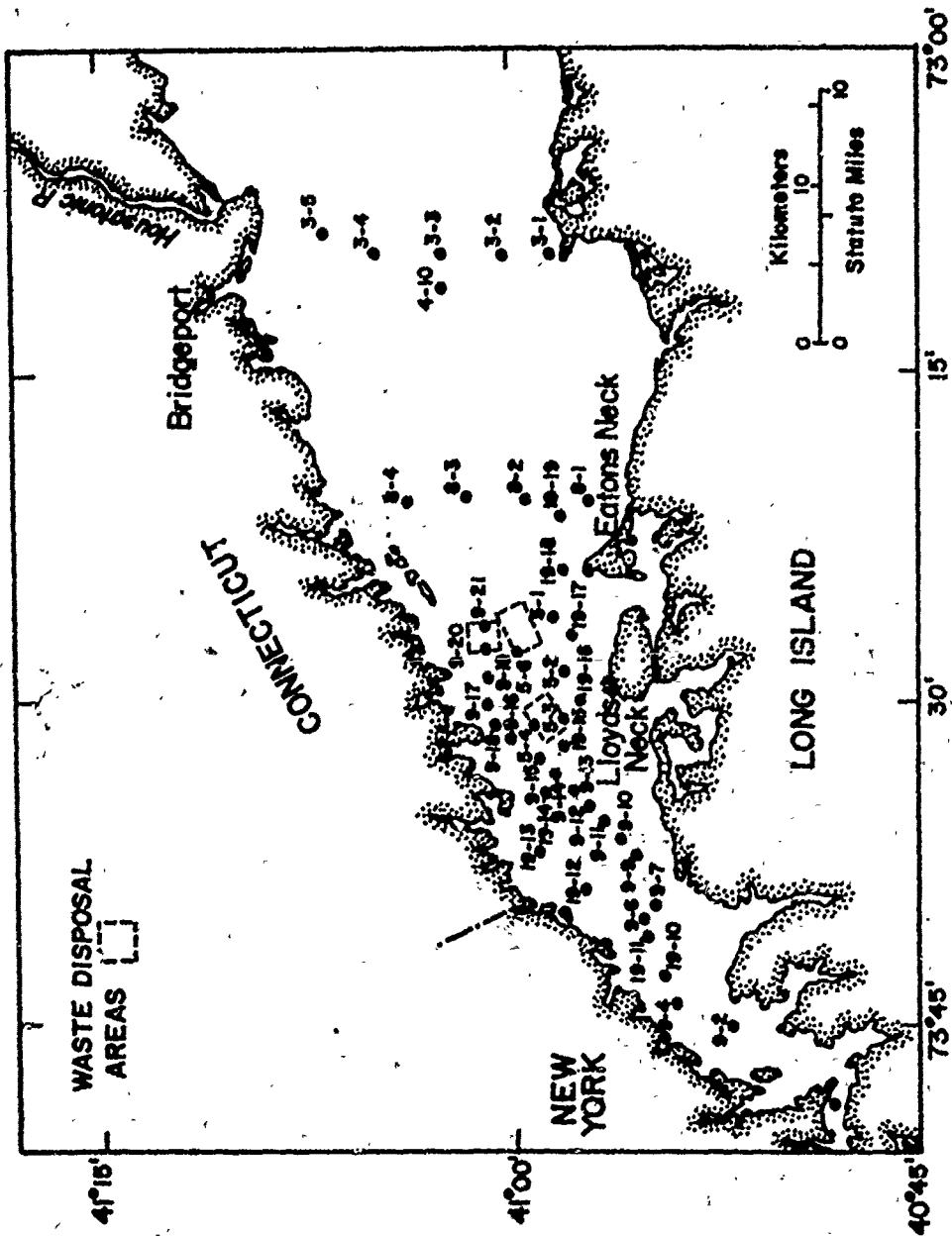


Fig. 6-1. Location of surficial sediments collected from Western Long Island Sound in June 1970.

collected for sediment analyses. At several stations paired grab samples were collected and each was subsampled as described above. Cores were collected by means of a Phleger-type short coring device. Longest core obtained was 45.5 cm.

Samples were washed from plastic sample containers into a sieve (230 U. S. Standard, mesh opening 63 microns) where they were washed and then dried under infra-red lamps. Depending upon the abundance of organisms, the samples were either sub-sampled using a microsplit (Skolnik, 1959) and counted; or, in some sandy sediments when organisms were scarce, they were concentrated by flotation in carbon tetrachloride (Cushman, 1948) and the concentrate counted. In each sample, more than 150 individual organisms were counted. Data are tabulated at the end of the chapter.

FAUNA

Fifteen species of foraminifera (Table 6-1) were identified (Table 6-2). Of these only nine species were represented by living individuals, that is, they were stained by rose bengal (Table 6-3).

Fewer species were encountered in this study than in the earlier studies reported in the literature.

In this study samples were collected almost exclusively from the silt-clay sediment (Table 6-2) where foraminiferal populations show few fluctuations in species composition and number. Buccella frigida, Elphidium clavatum and Elphidium incertum were the most common species both living as well as in the total populations (Table 6-3). These three species were commonly found throughout the area studied except in the East River. Elphidium subarcticum, Eggerella advena, Reophax dentaliniformes, Pseudopolymorphina novangliae, Fissurina laevigata and Ammonia beccarii were less abundant in Long Island Sound sediments, however, they were absent from much of Long Island Sound where they would normally be expected to occur considering water salinities, temperatures, and sediment types.

The ratio of the number of living species of foraminifera to the total number of species changes from values of less than one in the western portion to approximately one in the eastern part (Table 6-3). The trend suggests that in summer 1970 living foraminifera were more restricted areally than formerly. Comparison of these present data (live species/total species) with that tabulated by Schafer (1968, p. 30), shows a marked decrease in the abundance of living foraminifera in the extreme western portion of the Sound between 1965 and 1970.

The total number of living foraminifera per sample indicate higher values in the western and southern parts of the sampling area. The total number of individuals (live plus dead) per sample increase toward the west (Fig. 6-2).

The number of taxa represented in a given environment has been used (Walton, 1964) as a measure of faunal diversity. In general, the number of species or genera represented is considered to be inversely proportional to the stability of the environment (Walton, 1964, p. 209). Because of problems in taxonomic classification on the species level, a better representation of diversity may be obtained by use of higher taxonomic groups, such as genera.

In the present study the number of living genera represented in the samples from western Long Island Sound are significantly lower (only 1 to 2 genera present) than in central Long Island Sound where 3 to 5 genera are represented (Fig. 6-3). In this analysis fewer genera are represented in the dumping sites and areas adjacent to them (Figs. 6-1,3). However, this is not interpreted as a significant difference, owing to scarcity of samples in the disposal areas.

Table 6-1. Foraminifera observed in surficial sediment samples from Western Long Island Sound.

Ammonia beccarii (Linne)
Ammoscolaria cf. fluvialis Parker
Buccella frigida (Cushman)
Eggerella advena (Cushman)
Elphidium clavatum Cushman
Elphidium incertum (Williamson)
Elphidium subarcticum Cushman
Fissurina laevigata Reuss
Monionella atlantica Cushman
Pseudopolymorphina novangliae (Cushman)
Quinqueloculina seginulum (Linne)
Reophax dentaliniformes Brady
Reophax nana Rumbler
Trochamina squamata Parker and Jones
Virginulina fusiformis (Williamson)

Table 6-2. Data on sediment properties and abundance of foraminifera

Station	Depth (m)	Sediment Composition			Foraminifera				
		Sand (%)	Mud (%)	H ₂ S*	No. Live Species	No. Live Genera	Live	Total	Diversity (d)**
3-1	10	95	5	N	3	3	385		.33
3-2	36	64	36	N	1	1	8	120	0
3-3	33	10	90	N	3	3	72	840	.46
3-4	23	60	40	N	4	3	257	768	.54
3-5	17	80	20	N	2	2	752	7040	.15
5-1	21	10	90	Y	4	3	165	350	.57
5-2	22	5	95	N	3	3	160	644	.39
5-3	23	5	95	N	4	3	456	917	.49
5-4	30	7	93	Y	4	2	416	1496	.49
5-6	30	13	87	Y	3	2	49	620	.51
8-1	16	80	20	N	5	3	928	7824	.58
8-2	21	6	49	N	4	3	640	1152	.46
8-3	36	53	47	N	3	3	105	330	.44
8-4	15	91	9	N	7	5	74	568	1.39
9-2	21	7	93	N	3	2	848	2144	.29
9-4	18	10	90	N	2	2	912	3952	.14
9-6	16	2	98	Y	3	2	332	1388	.34
9-7	17	2	98	Y	4	2	896	1728	.44
9-9	17	34	66	N	4	2	232	968	.55
9-10	16	8	92	N	5	4	426	656	.66
9-11	18	17	83	N	6	4	552	800	.79
9-12	20	6	94	N	6	4	536	1048	.79
9-13	20	2	98	N	5	3	760	1364	.60
9-14	20	4	96	N	7	5	516	1224	.96
9-15	24	22	78	N	5	3	111	---	.85
9-16	36	3	97	Y	3	3	264	504	.35
9-17	17	90	10	N	5	3	208	1152	.75
9-18	25	2	98	Y	4	2	624	688	.46
9-19	23	6	94	N	2	2	72	304	.23
9-20	24	4	96	N	6	4	322	1072	.86
9-21	24	5	95	N	5	3	472	1048	.65
19-10	15	3	97	Y	3	2	274	4976	.35
19-11	19	3	97	Y	4	2	688	1968	.45
19-12	14	1	99	N	3	3	500	1862	.32
19-13	11	95	5	N	5	3	112	427	.78
19-14	22	2	98	Y	2	2	170	224	.19
19-15	23	8	92	N	4	3	616	968	.46
19-16	21	93	7	N	3	2	36	97	.56
19-17	18	7	93	Y	6	5	372	1340	.84
19-18	12	98	2	N	5	4	25	45	1.84
19-19	23	50	50	N	3	2	328	1320	.34

*N - No. H₂S Y - H₂S present**Margalef's Index of Diversity $\underline{d}, \underline{d} = (S-D/\ln N)$ where S = # of species and N = # of specimens

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Table 6-2. Data on sediment properties and abundance of foraminifera
(continued)

Station	Depth (m)	Sediment Composition			Foraminifera					
		Sand (%)	Mud (%)	H ₂ S*	No. Live	No. Live	Live	Total	Diversity (d)	
					Species	Genera				
<u>EAST RIVER**</u>										
19-04	21	95	5	N	0	0	0	0	--	
19-05	7	3	97	N	0	0	0	4	--	
19-06	14	67	33	N	0	0	0	5	--	
19-07	6	5	95	Y	1	1	0	5	--	
19-08	15	92	8	Y	2	2	40	272	.27	

**Sieved on a U. S. Standard no. 120 screen

Table 6-3. Occurrence of foraminifera (living and total number) at sampling location

Station	<u>A. beccarii</u>	<u>F. laevigata</u>	<u>P. novangliae</u>	<u>R. dentaliniformes</u>	<u>E. advena</u>	<u>E. subarcticum</u>	<u>E. ulcereum</u>	<u>E. clavatum</u>	<u>B. frigida</u>	<u>Number of Species</u>	
										Live	Total
3-1			X				X	X	X	3	4
3-2			X			X	X	X	X	1	5
3-3					X		X	X	X	3	7
3-4					X	X		X	X	4	5
3-5							X	X	X	2	4
5-1					X		X	X	X	4	5
5-2					X		X	X	X	3	6
5-3					X		X	X	X	4	5
5-4						X	X	X	X	4	7
5-6						X	X	X	X	3	8
8-1					X	X	X	X	X	5	5
8-2				X		X	X	X	X	4	5
8-3					X			X	X	3	4
8-4			X	X	X	X	X	X	X	7	7
9-2							X	X	X	3	4
9-4								X	X	2	5
9-6							X	X	X	3	6
9-7						X	X	X	X	4	5
9-9						X	X	X	X	4	5
9-10				X	X	X	X	X	X	5	6
9-11				X	X	X	X	X	X	6	6
9-12				X	X	X	X	X	X	6	6
9-13					X	X	X	X	X	5	7
9-14		X		X	X	X	X	X	X	7	7
9-15					X	X	X	X	X	5	-
9-16					X		X	X	X	3	5
9-17					X	X	X	X	X	5	5
9-18						X	X	X	X	4	4
9-19					X				X	2	5
9-20	X			X		X	X	X	X	6	6
9-21					X	X	X	X	X	5	7
19-4										0	0
19-5										0	2
19-6										0	2

Table 6-3. (continued)

Station	<u>A. beccarii</u>	<u>F. laevigata</u>	<u>P. novaezelandiae</u>	<u>B. dentaliniiformes</u>	<u>E. advena</u>	<u>E. subarcticum</u>	<u>E. ulcertum</u>	<u>E. clavatum</u>	<u>B. frigida</u>	<u>Number of Species</u>	
										Live	Total
19-7							X			1	2
19-8								X	X	2	2
19-10							X	X	X	3	6
19-11							X	X	X	4	4
19-12							X	X	X	3	5
19-13					X	X	X	X	X	5	7
19-14							X	X	X	2	3
19-15					X		X	X	X	4	4
19-16							X	X	X	3	-
19-17			X	X	X		X	X	X	6	7
19-18			X		X	X	X	X	X	5	6
19-19							X	X	X	3	3

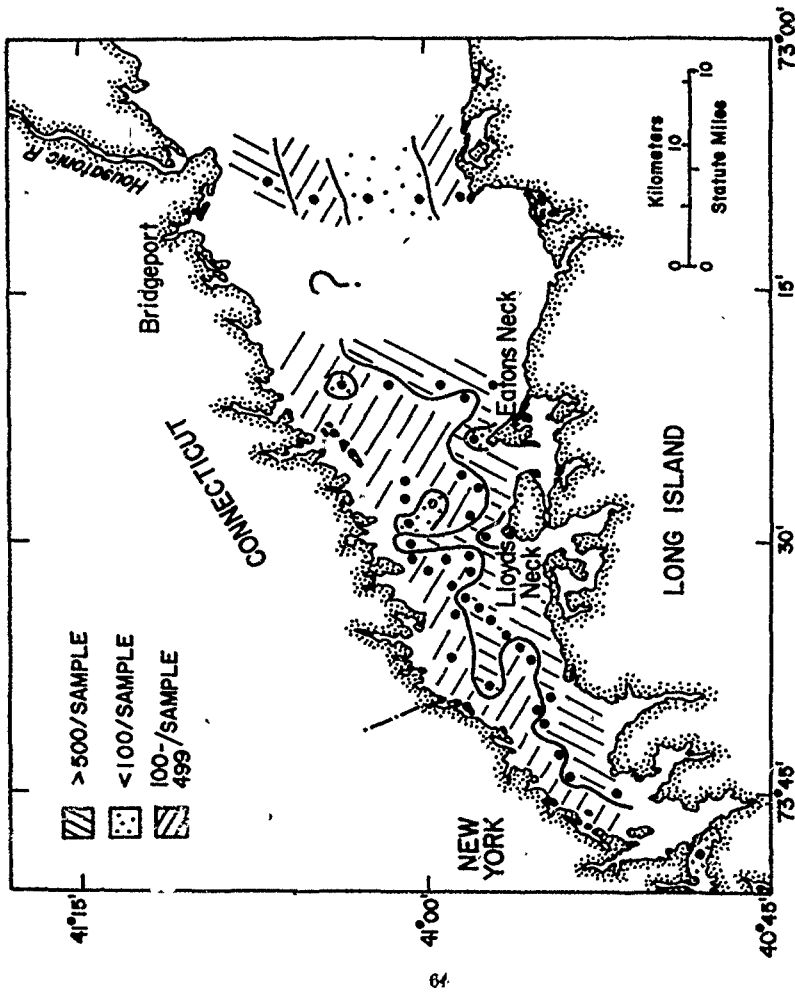


Fig. 6-2. Total number of foraminifera in samples of surficial sediment.

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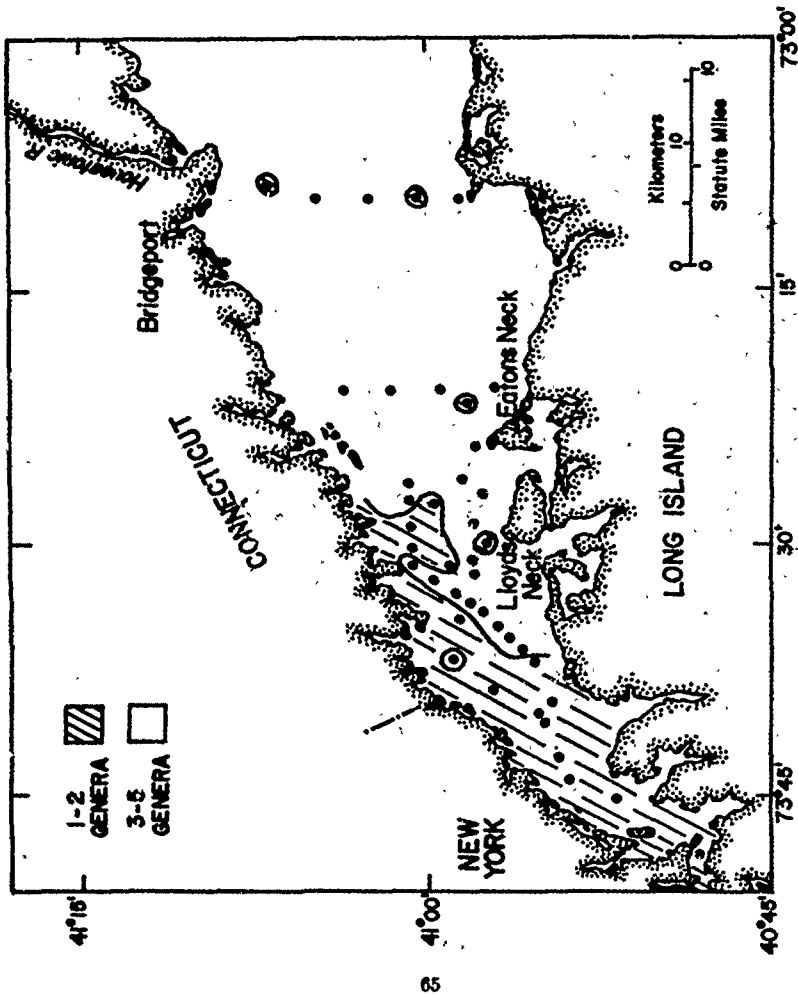


Fig. 6-3. Number of genera of foraminifera in surficial sediment.

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MARGALEF'S DIVERSITY INDEX

A more rigorous analysis of the data can be obtained using an "index of diversity", a calculated value which incorporates effects of qualitative and quantitative changes in the fauna. Margalef (1968) suggested that the stage of maturity of a community can be identified by species diversity, biomass, (organism mass, a measure of standing crop) and constancy of numbers, among other factors. Pioneering or immature communities can be recognized by low species diversity, large population fluctuations, and low biomass. A mature community can be characterized by high species diversity, little population fluctuation and relatively high biomass. In a relatively stable environment, a community will pass through the successive stages of development from immature to mature. The instability of the external environment may hold a community at a particular stage of succession indefinitely.

Margalef's Index of Diversity (d) is computed by:

$$d = (S-1)/\ln N$$

when S is the number of species, N is the number of individuals and ln is the natural logarithm. For populations of living foraminifera (Fig. 6-4) values for d ranged from 0 - 1.84 (Table 6-2). Diversity values proved to be highly variable at stations in relatively shallow water, usually with coarse sediments. The relative instability of the environment at these stations, due to hydrodynamic conditions may be responsible for these values. When only the relatively stable environments (those with sediments composed of greater than 65% silt and clay) are considered a definite pattern of foraminiferal diversity distribution emerges (Fig. 6-4). It depicts an area in the western end of Long Island Sound and along the Connecticut shore with significantly lower diversity index values.

The limited number of samples available indicate little demonstrable effect of waste disposal operations on diversity of distribution of foraminifera. In fact, mean values of d for six samples from the disposal sites exceed those of relatively unaffected areas (Fig. 6-4).

Cores ranging in length from 24.0 to 45.5 centimeters were taken in a west to east traverse. Preliminary examination of samples taken from core tops and bottoms from western cores show sharply restricted total faunas in surface samples with high diversity bottom faunas producing a high vertical diversity gradient. The magnitude of the vertical diversity gradient decreases in a west to east direction along the traverse, and in the eastern portion of the traverse the surface and bottom fauna register little or no difference in species composition.

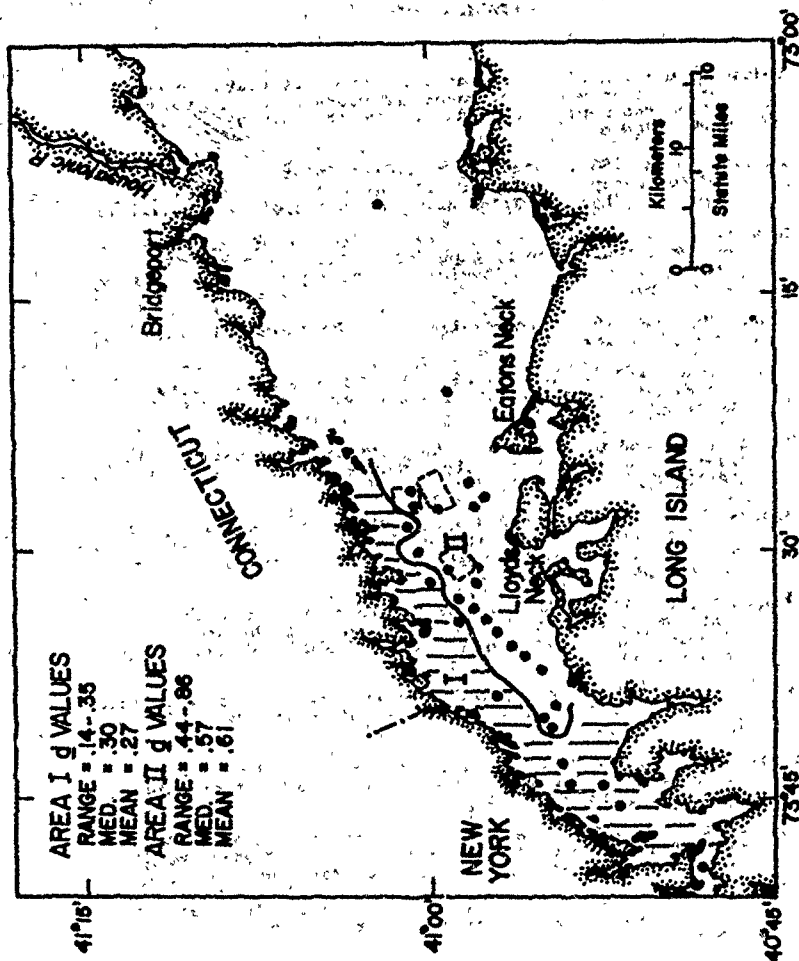


Fig. 6-4. Margalef's index of diversity for living foraminifera in surficial sediments.

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STATEMENTS OF INDIVIDUALS AND ORGANIZATIONS

The following statements have been received from individuals and groups who wish to have their views included in the record:

STATEMENT BY JACK BIRL, PRESIDENT AND EDUCATIONAL DIRECTOR OF LOCAL 199, CANNERY, FOOD PROCESSING AND MEAT AND POULTRY WORKERS UNION, AFL-CIO

The Cannery, Food Processing and Meat and Poultry Workers Union, Local 199, AFL-CIO represents 3400 members on the Delmarva Peninsula. The members are engaged in the processing of fish, oysters, clams, poultry and meat food products for general human consumption.

Local 199 was chartered on May 10, 1940 with its offices in Millsboro and Oak Orchard, Delaware. Over the 30 year period we have witnessed the steady decline in employment of seafood workers in the seafood operations along the entire coast of the Eastern Shore of the Delmarva Peninsula. The once active production in the oyster and seafood industry has over a period of 15 years been unable to continue employment of the seafood workers because of the decrease in the availability of products from the Atlantic Ocean and its tributaries. To our knowledge it is estimated that over 500 employees have either lost their jobs or are working part-time in the Seafood Industry because of pollution in the waterways.

In behalf of the members of Local 199 and their families, we demand the dumping of any and all material detrimental to the environment to be stopped immediately. We wholeheartedly support the Federal Investigation by the Subcommittee under the leadership of The Honorable Edmund S. Muskie and the Honorable under the leadership of The Honorable Edmund S. Muskie and The Honorable Senator J. Caleb Boggs of Delaware and J. Glen Beall, Jr., of Maryland. We urge them to get all the facts so they will be able to recommend effective control on all the dumpings and all other pollution of the water.

We appear at this special hearing to officially protest any further dumping of any and all kinds of material that may affect the Seafood Industry now or in the future.

Respectfully submitted to the Committee in session at the Rehoboth Beach Convention Hall on March 28, 1971.

STATEMENT OF THE DELMARVA ARTIFICIAL REEF ASSOCIATION

We, the directors and officers of the Delmarva Artificial Reef Association (DARA) would like to go on record as being opposed to the dumping of any materials or compounds in our bays or oceans, that would be detrimental to any form of marine life. We have seen materials and objects that were shown to us by the Stop Ocean Dumping Association (SODA) that were collected from the now existent dump site off the coast of Delaware and we object to this action and hope that thru adequate legislation this ocean dumping can be halted.

On the other hand we strongly believe that the dumping of constructive materials, such as old automobile tires, can and does perform a most useful function. We do not ask to be allowed to dump tires indiscriminately on the bottom but only in regulated and patrolled areas such as we already have. The purpose of such action is to build artificial reefs or fish havens that are actually a benefit to marine life. The people at Sandy Hook Sport Fisheries Marine Laboratory at Sandy Hook, New Jersey have been in close contact with various groups such as ours (DARA) in the construction of these reefs up and down the East Coast and to date they can find only beneficial results. We feel that in reality we are involved in an almost perfect project, i.e., the use of an unsightly, hard to get rid of object, used automobile tires, and turning them into a most useful, non-harmful—actually beneficial object such as fish havens.

We also feel we have another form of pollution that needs correcting. This pollution is in the form of the foreign fishing fleet that is constantly fishing the shores of our coast in utter disregard for the treaties that they sign with our country. Some of our local fishermen actually are fearful of setting gear in areas off the Delaware Coast for fear of losing the gear due to the foreign trawlers. Several commercial fishermen of our area have recorded with the U.S. Coast Guard actual losses due to the foreign fishing fleet. We are therefore unanimously in favor of extending the territorial limits of our coast line from 3 miles to at least 200 miles offshore.

CERTIFICATE OF INCORPORATION OF DELMARVA ARTIFICIAL REEF ASSOCIATION

First: The name of this corporation is Delmarva Artificial Reef Association.

Second: Its Registered Office in the State of Delaware is to be located at 2300 Cedar Street, Lewes Beach, Lewes, Sussex County, Delaware, and its Registered Agent is the Corporation at 2300 Cedar Street, Lewes Beach, Lewes, Sussex County, Delaware.

Third: The objects and purposes to be promoted and carried on by this Corporation shall be:

1. The Corporation is organized and is to be operated exclusively for charitable, scientific, and educational purposes. No substantial part of the activities of this Corporation shall consist of engaging in activities which are not in furtherance of one or more of the purposes for which it is organized, as stated below.

2. The objects and purposes of the said Corporation are to initiate a program of artificial reef construction primarily for the benefit of sport fishermen. It is organized to investigate various logistics and other problems associated with reef construction with the objective to organize interested persons, mostly sport fishermen, in such a manner that will enable them to build and maintain an artificial reef or reefs.

3. A secondary objective is to construct artificial reefs of waste clam shells, rubber tires or other materials appropriate, again to provide and promote a non-profit sporting program of a recreational nature for all interested sportsmen, and to promote, foster and develop friendship and sportsmanship between members.

4. To promote and foster said Corporation by acquiring property by lease or deed and to maintain, add to, or construct such buildings or equipment as shall be necessary to effectively accomplish this purpose.

5. To conduct, maintain and engage in means to thwart acts which attempt to destroy the State's natural resources for personal gain.

6. No part of the net earnings of this corporation shall inure to the benefit of any private shareholder or individual within the meaning of Section 501(c)(3) of the Internal Revenue Code as now in force or afterwards amended.

7. Upon dissolution of this corporation, its remaining assets, if any shall be distributed to one or more organizations organized and operated exclusively for religious, charitable, or educational purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code as now in force or afterwards amended, as the Directors of this Corporation shall determine.

8. This corporation shall not engage in any of the prohibited transactions described in Section 503 of the Internal Revenue Code as now in force or afterwards amended.

SUBJECT: EFFECT OF TIRES ON WATER AND WATER ON TIRES

SUMMARY

Research has little information on the extraction of materials from tires by water or on the resistance of tires to degradation by water.

There is qualitative evidence that tires do not harm the aquatic environment and that damage to rubber by natural waters is minimal.

Disposal of old tires, scrap tires and other rubber products under water in an abandoned quarry has several benefits.

DISCUSSION

Apparently water can extract some materials from rubber, and Korté (1) of the Food and Drug Administration has proposed a standard test method using

boiling water. He obtained extracts of 1-2 milligrams per square inch of surface area, but did not identify the constituents of the extract.

A series of articles by Hofman (2) gives sensitive methods for the evaluation of rubber intended to contact foods, as related to the German Food Laws. He also conducts his extractions with boiling solvents such as water, acetic acid, alcohol, acetone, and hexane, and recommends maximum limits for extracted antioxidants, accelerators zinc, formaldehyde, carbon black, etc. but gives no examples of actual results.

Rubber compounding ingredients may be classified as insoluble in a technical sense, and especially after vulcanization. Natural and synthetic rubbers, cords, beads, sulfur, zinc-oxide accelerators, antioxidants, extending oils, stearic acid, etc., are all insoluble in water. Moreover, those ingredients like accelerators and antioxidants which might tend to have water solubility have a far higher solubility in the rubber hydrocarbon and are not readily leached out.

Rubber is substantially not biodegradable. Some bacterial attacks on gaskets for drinking water pipe lines, especially in the presence of oxygen has been reported, but rubber is certainly not biodegradable in the sense of rapid fermentation, rotting, or putrefaction. Rubber tires and other products may not last forever when exposed to the elements, but they certainly would last for centuries.

If materials are extracted from rubber, they are at least non-toxic and harmless. Mr. Richard B. Stone, Department of the Interior, Bureau of Sport Fisheries and Wildlife. Has recommended old tires as artificial reefs on sand flats in the ocean as havens for fish. These old tire reefs, became coated in a few months with barnacles, hydra, algae, sponges, oysters, etc., and thus attract fish. These reefs also serve as refuges for the small fry, and promote increase in the fish population (3, 4, 5, 6, 7,).

The ratio of tires to ocean volume is very small. To test further the effect of old tires on aquatic life we set up a 10-gallon aquarium containing 2 lb. of ground tires from the reclaim plant and stocked it with sword tails, neon tetras, black mollies, and accidentally a few snails. The fish thrive and multiplied. The living young of the sword tails and mollies hid among the scrap rubber pieces and thus escaped from the predator audits. The snails multiplied to a population of a hundred or more. The aquarium was dismantled after 6 months because there was simply too much population in it, and because we felt that the point had been proved.

Water has no effect upon tires, at least no effect on good treads, and sidewalls. If the surface is cracked, water could enter through the cracks into any pores or channels along the cords or within them. Other than water logging, there would be no effect.

Tires and rubber products consist fundamentally of carbon and hydrogen, and are therefore combustible. Burning tires could constitute a severe smoke pollution problem. However, if they are submerged in water, the danger of fire by accident or arson is completely eliminated.

Most rubber products have a specific gravity of about 1.2, and should therefore sink. Tires will sink, too, if no air is trapped inside of them.

CONCLUSIONS

On the basis of the above discussion, and considering also a few other obvious factors, it appears that disposal of old tires and other rubber scrap in a water-filled abandoned quarry is reasonable and even beneficial:

- (a) They will be out of sight, not an eyesore.
- (b) They will be in a concentrated location, available for recovery by this generation or in the next for eventual use.
- (c) They will not be a fire hazard when submerged.
- (d) They will not cause harmful pollution.
- (e) Filling a deep quarry is a safety feature.

RESEARCH DIVISION.

REFERENCES

1. Korte, D. E., Jour. AOAC 53, 43 (1970).
2. Hofman, W., et al., Kaut, Gummi Kunstst, 21, 244, 318, 322, 368, 432, 481, 560, 620, 695 (1968); 22, 14 (1969).
3. Wall Street Journal, July 30, 1970.
4. Nemo and Observer, Raleigh, N.C., June 14, 1970.

5. Ward's Auto World, Aug-Sept 1970, page 63.
6. Skin Diver, July 1970, page 62.
7. Wingfoot Clan, Granville, Australia, Feb. 1969.

STATEMENT OF THE WATER RESOURCES ASSOCIATION OF THE DELAWARE RIVER BASIN

Mr. Chairman, my name is Paul Felton. I am Executive Director of Water Resources Association of the Delaware River Basin. Our Association is made up of 900 citizens who for the past 11 years have been concerned about the conservation and proper development of the waters in the 13,000 square mile Delaware River Basin. This includes the Delaware Bay.

In one sense, ocean dumping is outside of our Basin area of activity. However, alternates to ocean dumping of sewage sludge could very much affect Basin waters. For this reason I am sending you this statement for the hearing record.

There is increasing worry that ocean dumping of highly toxic materials is a practice that will eventually be detrimental to the continental shelf shallows.

The dumping of sewage sludge from Delaware Basin cities is also becoming an area of concern to oceanographers especially since the newspapers carried coverage on a sludge area devoid of fish life off New York Harbor.

As usual, in the pollution field, we don't really have complete and dependable research data about the impact of sludge dumping on the shelf area. And, as usual, we'll probably get new anti-dumping laws before the facts are forthcoming.

This will mean that some other method of sludge disposal must be found on an emergency basis until permanent disposal facilities can be designed, approved, financed and built, a time consuming process. Since stockpiling is next to impossible under city conditions this is not a simple problem. It will require much handling and rehandling which looks as though it will be quite costly.

We, therefore, suggest that any crash program developed by the Government through acts or regulations should take under consideration the cost of moving the dump areas outside the 12 mile limit as in the case of Senator Harrison A. William's Bill. Perhaps grants to States or Cities should be considered to help pay for increased sewage disposal costs resulting from the new regulations.

Permission to shift dumping grounds beyond the 12 mile limit should be seriously considered to provide sufficient time for the cities to work out new methods of taking care of the sewage sludge disposal or recycling problems.

We do not believe there is any cheap or easy alternate solution to ocean dumping.

It is our understanding that there are on-going studies by a number of research agencies to find out just how harmful ocean dumping of sludge is.

It may be that the results of this research will tell us that some degree of liquid sludge disposal can be absorbed by the ocean just as the Delaware River is accommodating waste effluents up to a point without detrimental effects.

Interim emergency action to halt dumping close to shore is probably justified because of the tidal pushback to beach and shore areas. However, long range rules and regulations on dumping should be based on factual data resulting from research still on-going. A flat close-down of all ocean dumping will result in a heavy impact of this waste on the air, water and land pollution load of our already overburdened upriver city areas.

STATEMENT BY ELMER J. HEWITT, INTERNATIONAL REPRESENTATIVE, AMALGAMATED MEAT CUTTERS & BUTCHERS WORKMEN (AFL-CIO)

My name is Elmer J. Hewitt. I am an International Representative of the Amalgamated Meat Cutters and Butchers Workmen (AFL-CIO).

The Amalgamated Meat Cutters and Butcher Workmen is a labor union with 500,000 members organized in about 700 Local Unions throughout the United States and Canada. These members are employed in the food, leather and fur industries.

I am here to appeal to you to stop ocean dumping off the Delmarva and New Jersey coasts. This legislative action is necessary to protect valuable food for the American people and to save jobs among workers who desperately need them.

The dumping has caused widespread pollution on the New Jersey coast. As a result, seafood which has been in plentiful supply in this area has been killed off. A highly nutritious food is being increasingly denied to hundreds of thousands of Americans, but the consumer is hurt even more for since an important supply of this seafood has been eliminated prices have risen. Thus Americans who want to eat shellfish have had to pay more as a result of pollution in this area.

Of great concern of our Union is the fact that the number of employees working on seafood in this area has been cut nearly in half, and will probably be reduced even further. Until recently some 925 employees worked for four firms in handling and processing seafood in the New Jersey area for the American consumers. Today these companies have only 500 employees. Listed below is a breakdown of this decline in the work force.

Company	Former number of employees	Number of employees, 1971
Snow Canning:		
Wildwood and Cape May, N.J.	320	220
Point Pleasant, N.J.	120	70
Riggin & Robbins, Port Norris, N.J.	95	40
Soffron Bros., Port Norris, N.J.	40	25
American Clam, Port Norris, N.J.	250	83

This loss of jobs is directly attributable to the pollution. It is tragic for many hundreds of men and women because many of them are still unemployed. In the current recession they are unable to find work. Also, although they are excellent seafood processors they are unskilled in other occupations. The work that they know simply does not exist any more and that work which does exist they do not know.

I therefore appeal to the committee to stop the ocean dumping and to take whatever steps are necessary not only to prevent further pollution, but to clean the existing filth from our waterways.

STATEMENT BY WILLIAM C. HENRY, P.E., COUNTY ENGINEER, SUSSEX COUNTY COUNCIL

The County Council of Sussex County being the governing body of the County and sanitary sewer districts formed under its authority, is vitally concerned with protecting the natural resources in the County and adjacent ocean areas. While County Council is avidly in favor of protecting our environment, it is concerned that arbitrary and unnecessarily severe regulations aimed at eliminating the adverse effects of barging sludge and industrial wastes may result in prohibiting properly treated secondary sewage treatment plant effluent from being discharged off shore.

The County is attempting to organize a regional sewer district to provide a central sewer system for densely developed areas not presently served and to provide a better and acceptable degree of treatment for the Town of Lewes and City of Rehoboth Beach. The plan envisioned in the preliminary engineering report depicts a one secondary sewage treatment plant near Cape Henlopen with an effluent holding reservoir to allow discharge through an ocean outfall on the out-going tides.

Although further studies will be made before final design, to reasonably assure our plans will not have a detrimental effect on the ocean by exceeding its assimilative capacity for secondary sewage effluent, we do not presently have an alternative plan to achieve our objectives at a feasible cost. County Council does not feel our plan would be significantly harmful to the ocean or shore environment, since many secondary and even properly treated primary effluents are discharged through ocean outfalls with no known adverse effects. Ocean City, Maryland discharges a primary effluent 2000 to 3000 feet off shore and there have been no undesirable effects reported.

County Council wishes to urge the adoption of regulations which will restrict ocean discharges of materials of such strength and density and in such locations that prove harmful to the ocean ecology but allow properly treated,

chlorinated secondary effluents to be discharged when properly located and dispersed. It is not logical to compare secondary effluent with solids concentrations of less than 50 parts per million with sludges containing 2000 times the concentration of solids.

STATEMENT OF CHARLES S. HORN

I am Charles S. Horn, a lifetime resident of the Delaware coastal area.

In various capacities and as somewhat of a hobby, I have studied—at first hand—the beaches and offshore waters of this area. I have personally witnessed many changes—in our shorelines and in our offshore waters.

Needless to say, I have not been pleased with many of the changes I have observed. This displeasure—even alarm—has resulted largely from the fouling of our waters through offshore dumping and through oil spillage that has periodically occurred off our coast.

On various occasions, I have personally observed, amid the debris cast up on our shores, foul-smelling, ugly filth that could have conceivably come from offshore sludge dumping areas.

I have also observed on our shores types of marine life such as would normally be found in the warmer waters of the Gulf Stream. As recent as November 2, 1970, I found—and photographed—"Portuguese Man O'War," which had been cast ashore by a storm-propelled high tide. You are undoubtedly aware that these creatures are normally not found in our offshore waters.

I call this to your attention in the effort to establish that materials dumped in the ocean as far distant as 133 land miles may well find its way to our beaches.

The number of land miles from our beach here, is, according to official—and factual—sources, actually 132.340 land miles (or 115 nautical miles) from the western edge of the Gulf Stream.

Prevailing currents, as determined by a careful study of tidal action, in and near our offshore waters, definitely establish that it is possible for filth from existing dumping sites, and particularly the sludge dumping area assumed to be only $7\frac{1}{2}$ miles off the Delaware Coast, to be dumped on our shores. All that is needed to accomplish this would be a severe offshore storm from northeasterly direction passing through the dumping area.

Acting as a private citizen vitally interested in ecology and other environmental matter, I urge you to not only curtail—now—the dumping of sludge just a short distance from our shore, but to ban any dumping of any toxic materials within 133 miles of our coast.

I have statistics, compiled over the past 55-60 years, that will substantiate the foregoing statements and other statements made here today by those opposed to any form of offshore dumping.

I am willing to make much of this information available to members of the Senate Subcommittee.

Thank you for this opportunity to present my views.

STATEMENT BY DR. LYNDEN V. KIBLER, CHAIRMAN, CONSERVATION COMMISSION, TOWNSHIP OF MIDDLETOWN

We have recently been notified of the hearing which you are holding at Rehoboth Beach, regarding pollution of coastal waters. We understand that you are interested in statements bearing on the dumping of sewage sludge and other waste materials in the ocean. Therefore, although we cannot attend the hearing in person, we are taking the liberty of sending our comments on this matter to you in the hope that they can be read into the record of the hearing.

Our Commission became interested in the pollution of the beaches of Sandy Hook and other areas in the County where our residents swim, and of the waters where our residents fish, over a year ago when we produced a report on the pollution of the waters surrounding and within the Township. From what we have learned in the course of writing this report, there is no question that the practice of ocean dumping is seriously detrimental to the economy, the ecology, and to man himself. We are pleased that the Federal government is showing enough concern to recommend legislation to control and phase out the practice.

It is apparent that serious damage has already been done to the ecology of

the New York Bight. The presence of a fifteen-square-mile blanket of sewage sludge in a normally productive area of the Continental Shelf is of itself an explanation of the steady decrease in edible shellfish and finfish of all types that the area has experienced. In addition, we understand that these wastes contribute heavily to the oxygen depletion that has caused excessive algal blooms and loss of fish in local waters.

Of possibly more serious consequence is the appearance of pesticides and toxic metals in the various dumps and their surrounding waters. Both of these materials are cumulative in the food chain. This can only mean that larger fish are absorbing steadily increasing amounts and, in turn, passing these on to man and other predators who eat them. This situation, obviously, will remain irreversible for a long time to come, and it is our feeling that action to prevent the situation from worsening is already late.

In addition to these major ecological effects, we cannot overlook the loss of revenue to fishermen, and shellfishermen, from declining fish catches and increasing closing of areas to shellfishing. Much of the income of the area also depends on the resort trade, and the return to the beaches of objects originating in the sludge dump hardly produces an attractive—or even a safe—situation for visitors or local residents.

We are aware, too, that actual pathogens have been found in shellfish and that many fish suffer various forms of infection. The possibility of an epidemic, or of increasing occurrences of sub-acute infection among people seems all too probable.

We sometimes feel that we are working against overwhelming odds to produce beneficial changes in the environment before it is too late. We are confident that the Congress will come to our aid by passing appropriate legislation to phase out the dumping of wastes in the ocean. Certainly the need for such legislation seems irrefutable.

STATEMENT BY THOMAS L. KIMBALL, EXECUTIVE DIRECTOR, NATIONAL WILDLIFE FEDERATION

This letter is in response to your invitation to enlarge upon our original testimony before the Subcommittee on ocean dumping. We welcome the opportunity to make these additional remarks.

We should like to compliment you and the others who have been holding special hearings on ocean dumping along the Atlantic seaboard. We believe these hearings perform a useful and highly significant function, both in alerting the public to these problems and in developing information for the Subcommittee.

We note that your particular attention is being directed to five bills currently before the Subcommittee on this one topic. These are: S. 192, the "Marine Pollution Control Act of 1971"; S. 1011, the "National Marine Water Pollution Control and Quality Enhancement Act of 1971"; S. 1082; S. 1238, the "Marine Protection Act of 1971"; and S. 1286, the "Emergency Water Pollution Prevention Act of 1971."

Basically, the Federation does not believe that the oceans or Great Lakes or other areas which constitute the U.S. shorelines should be used for dumping or waste disposal purposes. We note with considerable interest that S. 1082 and S. 1238 define wastes or material as matter of any kind or description, including, but not limited to, dredge spoil, spoil waste, garbage, sewage sludge, munitions, chemicals, biological and radiological agents, radio-active materials, wrecked or discarded equipment, rock, stone, or industrial waste. S. 1286, less specific, relates to "any material" while S. 1011 defines wastes as matter of any kind or in any form. S. 192 is specific and covers many of the same materials as in the other bills. After reviewing these definitions, *we cannot see any valid reason for using the Nation's offshore water areas for disposal.* For far too long, this has been another indication of the "out-of-sight, out-of-mind" attitude toward waste disposal, and we no longer can afford this type of degradation of the environment.

If any dumping is to be allowed, however, then we generally are in agreement with the below-listed principles which are expressed by one or more of the bills under consideration.

1. We agree that a permit system, to be administered by the Environmental Protection Agency, should be established. We note that S. 192 would terminate all dumping after June 30, 1975, a procedure which, in effect, gives dumpers

until that time to make other arrangements. In our opinion, this is a reasonable approach if the Subcommittee feels that immediate and complete cessation of dumping is not practicable. We note that S. 1082 sets a five-year deadline.

2. It is our firm belief that any regulation of dumping should apply to all U.S. waters and the oceans outside this Nation's territorial waters and the contiguous zone. In this connection, we like the definition contained in section 3(b) of S. 1238 which specifies the coverage as: "oceans, gulfs, bays, salt water lagoons, salt water harbors, other coastal waters where the tide ebbs and flows, and the Great Lakes." We believe this wording is superior to that in S. 1286 (estuaries areas, territorial waters of the U.S., and the high seas beyond), or S. 1082 (estuarine areas, coastal waters, Great Lakes, territorial waters, and adjacent high seas), or S. 192 or S. 1011. Presumably, smaller fresh water areas are covered by the Refuse Act.

3. We think it is appropriate for the Environmental Protection Agency to be empowered to issue permits, if any dumping is to be allowed, if the action will not degrade the environment or ecological systems or endanger human health, welfare, or the amenities. S. 1238 appears to give the EPA Administrator more discretion in issuing permits than the other bills and we like the provision in this proposal which burdens the applicant with providing information to justify a permit.

4. We agree that the EPA Administrator should be authorized to designate by a permit the type and amount of materials to be transported and/or dumped and the location, as well as the period of time that the permit is valid. This is outlined in S. 1238. And, we also are in accord with that proposal's requirement that a permit shall not violate applicable water quality standards.

5. We hope the Subcommittee will give thoughtful consideration to two points in S. 912: to public hearings on permit applications, and to having EPA decisions reviewed by the Council on Environmental Quality.

6. We concur with the principle expressed in S. 1238, whereby EPA will establish and apply criteria for reviewing and evaluating permit applications. We prefer this discretionary process on criteria above those which apparently would establish more formal regulations, as in S. 1286 and S. 1011.

7. We do not disagree with the provisions which have the Department of Justice responsible for conducting any legal actions which may be necessary, or with surveillance by the Coast Guard. However, we do note a wide variance in the amounts of maximum fines to be applied to violators for each offense: \$10,000 in S. 1011, \$50,000 in S. 1238, \$50,000 in S. 1082, and \$25,000 in S. 1286. Penalties should serve as deterrents and we question whether \$10,000 is enough in some instances. On the other hand, penalties can be so severe that many courts would be reluctant to impose them. However, in our judgment, we do not feel that \$50,000 is so severe as to impede such sentencing.

8. We are intrigued by section 7 proposed in S. 1082, and commend its sincere study by the Subcommittee. This would provide for determining means of recovering useful material from wastes. Certainly, if a negative like waste can be transferred into a positive value, the entire environmental movement will have been strengthened.

We welcome this opportunity of making these remarks and will be pleased to have them made a part of the official record of the hearings.

STATEMENT BY GEORGE LAFFERTY

I would like to have this statement made a matter of record for the Subcommittee on Air and Water Pollution of the United States Senate.

I attended the open hearing in Behoboth Beach, Delaware on March 28, 1971, and spent most of the day there. Of all the expert testimony I heard, no one came close to the real extent of damage done by this type of pollution. According to a scientist from the Franklin Institute who was representing Philadelphia's interests, it takes six hours for the Ocean to dissolve these polluted wastes, during that time I content that these wastes destroy or mutilate untold trillions of microscopic life before it is diluted to the state where it is not harmful. The real danger is not to the full grown Marine Life but to the sperm. The clam for an example produces approximately two million seeds at one spawning session and these seeds have no protection from this form of pollution.

STATEMENT BY HARRY LOZOUR, PRESIDENT, GREATER CAPE MAY CHAMBER OF COMMERCE

As the president of the Chamber of Commerce of Greater Cape May (N.J.), I have been delegated to represent the Chamber of Commerce to protest the further dumping of all dangerous materials that will further contaminate our oceans.

We are specifically concerned with the area 5½ miles off the coast of Cape May Point, New Jersey, and 7½ miles off Lewes, Delaware, or the 110 sq. miles that has been designated off limits (by the F.D.A.-N.J.) to the shellfishing industry.

We are deeply concerned that this continuous dumping reflects a serious economic impact on this county of Cape May. Any continuation of this ridiculous means of disposing of deadly materials into our oceans will surely put the entire economy in a very precarious and dangerous economic position.

We are not only alarmed by the losses that have already been experienced in our fishing and clamming industries, but feel that this will surely jeopardize our very, very important vacation seashore economy, for we are of the opinion that it is not inconceivable that the refuse could be washed up on our seashores and beaches—the finest in the entire world.

We respectfully insist that state and federal legislation be passed immediately to stop this senseless use of our oceans as a dumping area.

STATEMENT BY MR. DORSEY L. LYNAM

I urge you, Senator, to vote for a delay in the passage of the pollution measure which would prevent barging of waste to the ocean, until results of testing can be received about October 1st; on the part of the Company where I have been employed for over 30 years.

I wish you continued success as you represent individuals, industries and the public good, and assure you of my continued support for good government.

STATEMENT BY WILBUR J. OSTRANDER, PRESIDENT, STOP OCEAN DUMPING ASSOCIATION, WILDWOOD, N.J.

On October 15, 1970, a boat trip was arranged with a large group of noteworthy officials, newsmen, fisherman and shellfishermen to investigate the sludge dumping area 5½ miles off Cape May Point, N.J. and to make a determination of the 110 sq. miles of this polluted area closed to the fishermen prior to that time.

A dinner meeting was held at the Lobster House, Cape May, N.J. on November 11, 1970, at which time scientists, oceanographers, state and county officials, fishing and clamming representatives discussed not only the problem, but to find answers on how and when ocean dumping off the New Jersey and Delmarva coasts could be stopped.

Shortly after the dinner meeting the SODA organization was formed, duly recognized by the State of New Jersey as a non-profit organization.

We feel that through the strivances and pressures of SODA, funds from the federal government were withdrawn which would have allowed the City of Baltimore, Md. from using the same sludge area as the Cities of Philadelphia, Pa., Camden, N.J. and Bridgeton, N.J. were using.

(About seven weeks ago Mayor Aitken of Bridgeton announced that the City of Bridgeton will halt the barging of their sewage-sludge into our ocean.)

The SODA organization, and through the efforts of an injunction by Congressman Charles W. Sandman, Jr. (NJ), were able to stop Bucks County, Pa. from dumping very dangerous chemicals 47 miles off our coastlines.

On February 26, 1971, another boat trip was arranged to the sludge dumping area with another large group of officials and scientific people among whom in attendance was Dr. Gordon F. MacDonald, author of *OCEAN DUMPING—A NATIONAL POLICY*.

On March 26, 1971, a U.S. Senate Subcommittee on Air and Water Pollution was held in Rehoboth Beach, Del., chaired by Senator Edmund S. Muskie, on ocean dumping.

Legislation hopefully will be passed this year by state and national representatives to disallow dumping of any kind in our ocean within the 100-mile limit,

through the efforts of the SODA organization. Without the efforts of SODA these things that have happened the past few months we feel would not have taken place. Our goal is to eventually stop *all* ocean dumping.

We would appreciate having a few copies of a full transcript of the hearing. Thank you kindly.

As per our previous conversation, I am forwarding the list of names of those who participated in the boat trip to examine the designated dumping site per-
ted by the Army Engineers in our Delaware Bay. The list follows:

Donald Brunnell, 395 W. Glenwood Avenue, Wildwood, N.J. 08260.
Elmer Strauss, c/o The Lobster House, Cape May, New Jersey 08204.
Mayor Anthony T. Catanoso, 219 E. 12th Avenue, North Wildwood, N.J. 08260.
Senator Harrison A. Williams, Senate Building, Washington, D.C.
Capt. Otto Stocker, Party Boat Association Past President, 6000 Park Blvd., Wildwood Crest, N.J. 08260.
Tom Sawyer, Snow Food Products, Wildwood, New Jersey 08260.
Erik Kirkeberg, 701 W. Burk Avenue, Wildwood, N.J. 08260.
Sexten Carlson, 304 W. Andrew Avenue, Wildwood, N.J. 08260.
Capt. Andrea Lippi, Cape May Point, New Jersey 08204.
Harold Snow, Pine Point, Maine 04604.
Ray Martin, 215 E. 12th Avenue, North Wildwood, New Jersey 08260.
Jack Wiegand, 714 Whildane Avenue, North Cape May, New Jersey 08204.
Palmer M. Way, Jr., 6000 Pacific Avenue, Wildwood Crest, New Jersey 08260.
Donald W. Long, Wildwood Clam Co., 5406 Pacific Avenue, Wildwood Crest, New Jersey 08260.
Robert H. Nicholson, RD 1, Box 21, Mill Pond Acres, Lewis, Delaware.
Leonard Isgrande, 10 Hilltop Road, North Darmouth, Mass.
Johnny L. O'Connor, 1308 Neptune Avenue, Newport Beach, California.
C. Shoffler, Clam Boat Captain, Towerview Road, Erma, New Jersey 08204.
Richard E. Bells, c/o State Food and Drug Administration, Trenton, New Jersey.
James Verber, Field Service Shell Sanitation Department, Rhode Island.
Palmer Holmes, Old Shore Road, Erma, New Jersey 08204.
Max J. Grimes, Party Boat Representative, 1279 Washington Street, Cape May, New Jersey 08204.
Mayor Robert Hentges, West Wildwood, New Jersey 08260.
Mayor Charles Masciarella, Wildwood, New Jersey 08260.
Mayor Joseph Von Savage, Wildwood Crest, New Jersey 08260.
Andrew C. Nielsen, 427 W. Andrew Avenue, Wildwood, New Jersey 08260.
Mervin Kent, Editor, Cape May County Gazette, Cape May Court House, New Jersey 08210.
Peter Lamonica, c/o Cape May Clammers, Box 158, Cape May, New Jersey 08204.
Mayor Frank A. Gauvry, Cape May, New Jersey 08204.
William H. Woods, Ocean City, New Jersey 08226.
William J. Hughes, Congressional Candidate, Ocean City, New Jersey 08226.
Joseph Olwell, 202 E. 22nd Street, North Wildwood, New Jersey 08260.
Mrs. Liby Wallace, Secretary, Shellfish Institute, 22 Main Street, Sayville, New York.
George Meyer, Public Health Shellfish Consultant, 26 Federal Plaza, New York, N.Y. 10007.
William Riggins, Riggins and Robbins Shellfishing, Port Norris, New Jersey.

COMMISSIONER WILBUR J. OSTRANDER OF THE CITY OF WILDWOOD

Good evening, ladies and gentlemen, and welcome. At this time I would like to introduce the following beginning at my left:

The Honorable Mayor Charles Masciarella from the City of Wildwood.

The next person I am sure went through great weather difficulties getting down to this area. He came all the way from the northern part of the State. He is a very prominent gentleman, and with great special pleasure I have the honor of introducing Dr. Harold Haskin.

The next gentlemen flew in from New York and we're delighted to have him with us and he's Captain James Verber.

The next person is one of the most delightful individuals I've ever talked to on the telephone. She is a very special person in this group; a wonderful lady—exciting and beautiful—Mrs. Elizabeth Wallace.

We are pleased in having a man who is probably the most astute in the State of New Jersey and is very, very concerned with the problems we have in this area—Mr. Richard Bellis.

Perhaps many of us in this area in the long range have been protesting and using all of their mental capacities to try to overcome the problem for many, many years. One of those individuals is Mr. Bill Kleb.

We are especially blessed by having our political figures on the list because believe it or not, they are alarmed; they are interested; they are concerned; and they came this evening to try to find some of the answers that you in the shell-fishing and fishing industry are trying to find, and one of those individuals is Robert Kay. He is a splendid and wonderful man.

I talked to a gentleman on the phone yesterday, and in my behalf has honored this community for many, many years. I don't think that anyone can ever be able to take his place, and that person is our favorite, Superior Court Judge A. J. Casiero. Along with him is his son, the Honorable Senator James Casiero.

There's a member of the Board of Freeholders here, who is interested, sincerely interested in this problem, and I'm referring to Dr. Leon Schuck.

The Mayor of Stone Harbor has also joined with us. He is certainly excited and upset over these things which have happened along our shores, and I'm speaking of The Honorable Mayor William Lange of the Borough of Stone Harbor.

The next gentleman is somewhat of a favorite of mine, and I think he's tremendous and he's a wonderful guy, and I'm speaking of The Honorable Mayor Joseph Von Savage of the Borough of Wildwood Crest.

You know it's going to be quite a challenge tonight to determine which person should speak first, because there are many qualifications here, and I suspect that there'd be a little bit of forbearing in my small evils in the sense of judging those who are of great importance in numerical order. I'd like to call upon Dr. Harold Haskin to speak to you on some of the things they are attempting at Rutgers University.

DR. HAROLD H. HASKIN, DEPARTMENT OF ZOOLOGY, RUTGERS UNIVERSITY,
NEW JERSEY SHELLFISH RESEARCH

Thank you Mr. Ostrander. This is the first moment that I knew that I was expected to say anything. I received a phone call the day before yesterday from Bill Taylor, stating this problem with the dumping site off the Wildwood coast, and would I come down and sit with some people and chat about this with them. It's quite a surprise to walk into this group tonight and see the size of the assemblage.

I think as the Commissioner said, "This is a real indication of the grave concern with this serious problem off the coast." I knew that my old friend, Capt. Jim Verber had been involved with this because we've talked about the problem some years ago, and I tried to call him in Rhode Island today and learned that this was a federal holiday and couldn't get hold of him. I was quite astonished and very pleased to walk in here tonight and find him sitting at the head table. We've known each other, we figured about twenty-odd years, and have talked about oceanographic problems over that period of time on several occasions.

In this particular session tonight the problem that faces us, I think many of us have been concerned with over the years, with this question as to what we do with the waste that besets our civilizations. Where is the best place to put it to keep it out of our way where it will not be harmful to other members of our society. This particular situation was brought to the forefront about five or six years ago with a letter to me from then Commissioner of Health, Dr. Crandall, stating that the City of Baltimore was proposing to barge sludge to the area off the Delaware Capes and did we have any comments about the location that should be selected for this. And he indicated in a letter he sent me, where the approved dumping site was at that time.

Libby, you were chatting about this a little while ago, too. Libby, I think got in on those discussions at the same time and remembers the semi-shock we had at the time realizing that when that site had been picked, no one apparently paid very much attention to the current system in that area or the basic hydrography.

In our group, about 20-odd years ago, we've done some hydrography in that area, studying the current patterns, bottom situation and so on for the U.S.

Navy as part of its general East Coast Program on Anti-Submarine Defense. At that time it had been determined that in terms of the flow of water in and out of the bay, the major part of the salt water that came into the bay was coming in around the tip of Cape May. The major portion of the fresh water is coming out along the Delaware shore, so that if one were picking the site in which to dispose of materials that one didn't want to get back inshore, the place one would not put this would be toward the Cape May side, because here you have the return currents that's coming in along the bottom bringing the salt to the bay.

In the dividing line, as shown by this study of ours, and amplified by studies of some of our colleagues at Woods Hole Oceanographic, indicate that the dividing line indicated between the inflow and outflow was a line drawn roughly southeast in a position of the old lightship that used to sit out here about three miles off Cape Henlopen. So a recommendation by Dr. Crandall at that time was it had to be a dumping site off the Jersey Delaware Capes; that it should be located south of that particular line. Of course, as this condemned area appears in the paper, that which is centered about the present still approved site, it's still the old, old location that we had since anyone started dumping off these shores. So obviously, oceanographic information in this particular case, had very little influence on the position of that site.

I think other people here, particularly Captain Jim Verber, will have much more knowledge than I about what may be done about this thing now that it exists. I think we have to be realistic. There is a national policy now that recently instituted that these ocean dumping sites will be phased out as soon as practical. That, I suppose, means as soon as there is some other way found to dispose of the wastes of our society. Until that's done, I think we have at least ought to minimize the damage of the marine environment. Perhaps a better surveillance program, a closer watch on these things, and a consideration of more favorable sites, and perhaps the one that's been picked here would be very much in order.

You have a big list of people here at this front table, Commissioner, and I'm not going to hang on. It's a very great pleasure to be here, and I'm looking forward to what the rest of this group of people have to say tonight. Thank you very much.

Commissioner OSTRANDER. Thank you very much, Dr. Haskin. There's another gentlemen I have not met until this evening, and I would suspect that he's a most astute, informed person, and I'd like to have him come to the "mike," but before we have him to do this, he drove his lovely wife down, and I'd like her to stand for an applause—and that's Mrs. Albert Eble. Will Mrs. Eble stand, please?

DR. ALBERT F. EBLE, TRENTON STATE COLLEGE, NEW JERSEY MARINE SCIENCES CONSORTIUM

Thank you, Mr. Ostrander, and like Dr. Haskin, I, too, received a telephone call inviting me down to chat with most of you folks about what could possibly be done about this situation, and I certainly echo what Dr. Haskin has said. I can tell you this, that recently we had the good fortune of hearing a talk by Dr. Jack Pearce from the Sandy Hook Marine Laboratory, where his laboratory has been conducting studies (bottom studies) up and down the coast, particularly in around the New York Harbor area, where New York and Jersey have been dumping their sludge for many years now.

The work of Dr. Pearce shows a very brief picture—the area that is marked off. And interestingly, the area up in the Jersey-New York area is very similar to this one, where it is picked, unfortunately, to be about equal distance between New York and New Jersey, and from the little map we have that was on the chair, I notice that the sludging area in this neck of the woods, seems to be about equal distance between New Jersey and Delaware. I guess, Dr. Haskin, the reason it was picked was not because of any of your hydrographic studies, unfortunately, but because it didn't seem to favor one state or the other. At any rate, Jack's studies were very, very graphic.

The bottom of the Continental Shelf out here is mostly sand and supports a large variety of animals, as you know, surf clams, among other things. But also many different kinds of bottom animals. Some of the research at Sandy Hook Marine Laboratory done, such as putting down artificial reefs, and watching the succession of organisms on these reefs was very interesting. As the dredging noted

sites, near the dumping area of the sludge, fewer and fewer organisms were found. Finally, within this sludging area, the nature of the bottom can dramatically change. In this area one found this a deep muck. As you might suspect, very frequently the more soluble material from this sludging would also come up onto the surface so there would be a definite film on the surface. The muck itself was absolutely devoid of any life, no organisms living in this at all. As a matter of fact, rather just a qualitative kind of a dredge where they would throw the dredge overboard and let it scrape the bottom for about three to four minutes reveal that a profusion, not of any animal life, but rather an evidence of another kind of a civilized animal that lives up on the land and evidence of a female animal actually, because the bottom of the area where all of the sludge is being dumped was mostly the tampons and kotex—particularly the plastic liners. Jack Pearce was commenting on that this was the most frequent find. So it looks as if we have a tampon community on the bottom other than a surf clam community in the sludging area.

As far as what can be done about this, well, certainly something will have to be done. I agree with Dr. Haskin that we do have to continue putting this material somewhere. The Corps of Engineers was also careful to point out to us that they had contacted many eminent scientists and the consensus of opinion was that until something better can be found, and I think that this is our job—all of our job to find something better. Until something better can be found, then this seems to be the best way to get rid of it. Certainly you can't stop doing what you're doing, because if you're going to do that, then you're going to get some other avenue of disposing of this material. But to continue doing this, and not having meetings like this would indeed be a shame, because this is slowly blanketing our marine environment. And will eventually, as this continues, kind of snuff the whole thing out. I'll make way for other speakers. Thank you, Mr. Ostrander.

Commissioner OSTRANDER. It occurred to me that perhaps some of the scientific-minded folks would express their considerations first for reasons that maybe you and I can become a little more acquainted of ridding the problem—that is the frustration of trying to find the solid answer. By this means we will perhaps understand both sides of the picture. There's another gentleman who came down today through all of the rain and storm, who is intensely interested in the problem, and I'd like him to express his views and to help us find the answers that we're trying to find. That would be Dr. James B. Ridlon.

DR. JAMES B. RIDLON, NEW JERSEY MARINE SCIENCES CONSORTIUM

The one thing Mr. Ostrander failed to mention is that my position is the Director of the New Jersey Marine Sciences Consortium. I won't stand up here to expound as any expertise in the field that you're concerned with. I'll leave that up to Dr. Haskin and Dr. Eble. However, I would like to set up a plug for our organization. It's not a plug for the sake of a plug, it has a purpose. Perhaps many of you do not know, or heard of the Marine Sciences Consortium. If you have, perhaps you do not know what its objectives are. We are an organization that represents all of the states colleges and all of the county colleges in the pursuit of marine science study. We hope to have more colleges of the State in our organization.

Our objective is to provide facilities and equipment to these member institutions for marine science study work. Perhaps our greatest contribution to your cause in that we would provide the technical capabilities through education and technical assistance through expertise from the various other institutions to do research work on such as your problem. I won't say much more tonight, except to say this:

For anyone, such as you, who have a cause in a field of pollution control—that in order to make any cause such as yours a success, first of all, we must have a well-informed public. A well-informed public is one that establishes policy through their concern. Secondly, you must have technically trained personnel, and this is where we come in, in the long run, and I suggest that any technically trained personnel that could follow studies that you demand, should first of all come from this State, aside from that, that of course you would have to draw up from other quarters.

Third, but not least, you must make the youth of this country even more aware than they are. And they are very aware of our environmental problems. But you must keep them interested, and must keep them very concerned, because they are what you represent today, or they will be what you represent today in the future.

I will, unfortunately, bring out a point here. I rather hesitate to say this, but it is a fact, that this State is well behind many coastal states in Marine Sciences studies. This is unfortunate. We hope, along with others, at least it's our objective to try to correct this. In a State such as this, that has such a coastline, it depends a lot on its natural resources. It's a shame they're so far behind many of the other coastal states. Hopefully we will contribute a lot to the correcting of this problem. I want to thank you very much."

Commissioner OSTRANDER. There is another name written on a card here and his name is William E. Waters from the Natural Resources Council, Department of Environmental Protection. I wonder if he has a message? Would you step up please?

WILLIAM E. WATERS, NATURAL RESOURCES COUNCIL, DEPARTMENT OF ENVIRONMENTAL PROTECTION

Thank you, Mr. Ostrander. Ladies and gentlemen, This is far from my program this evening to come here and have anything to say, but I read of your program in the paper and I made it a point among my activities today to see about coming here this evening and listening. This is what I've been doing is listening.

I happen to be a member of the Natural Resources Council, and we've been faced in the last few months with the problem of great concern to various industries in the northern part of the State to review their maintenance dredging around the Arthur Kill River and at the Jersey shore, up on the Jersey City area. The question comes up: Do you deny these people the right to do their maintenance dredging and remove the sludge and dump it out off into our coastal area, or do you jeopardize the shipping facilities? It's a real problem.

It's just like I've heard here so far, it is a big problem. It faces us today with this dumping of sludge and etc., but I like to feel personally, I am not in favor of it. I feel that it is wrong, but you can't stop a problem by creating a problem. Until the time comes when we can make some determination, what do we do with this material?

There's a differential here between maybe human waste sludge and the sludge that is necessary to be removed from some of the rivers and harbor areas that have to be done annually by maintenance dredging. There is definitely a difference here when you talk about organic waste sludge disposal. It's one problem with the dredging and the maintenance of the harbor facilities where they have to remove this so-called sludge, in order to let their boats dock and etc.

Some of the men whom I've heard speak said that it is not a contamination factor when it's dumped out in this dead sea area. This is very interesting, and that's why I'm here, to try to educate myself a little better along these lines. I think that something like this type of meeting is real helpful. I'm sympathetic with the problem, and I wish somebody could come up with a positive answer. I am very much aware and would like to be as helpful in any way possible. Thank you for your time.

Commissioner OSTRANDER. There's a gentleman who came down tonight through the tremendous rain because of his intense interests in the problems of the entire State Health Department of New Jersey. He did take it upon himself a few weeks ago to participate. He's a wonderful man. He left his family to be here because he would hope to find an answer to the problem for us, or contribute some meritorious deed to overcome it. And that gentleman is Mr. Richard E. Bellis of the New Jersey State Department of Environmental Protection.

RICHARD E. BELLIS, N.J. STATE DEPARTMENT OF ENVIRONMENTAL PROTECTION

Thank you very much, Commissioner. I think you already heard that your presence here is very encouraging, and also very indicative of your interest in this problem. The problem is not going to be solved tonight, and it may be

a long while before it is ever solved. But I think our best purpose here this evening is to try and give this whole project some direction. My interests for the interest of my immediate organization is that of providing shellfish to the general public of good quality, that there is no fear of consuming. New Jersey is No. one in the United States in the production of the species of over which we are most concerned tonight.

Spisula Solidissima. The surf clam, the sea clam, the ocean cold quahog, whatever you want to call it, it's out there and it's being dredged up and we're producing the most of that beast throughout the country. What's happening now is that this dumping area for sewage sludge is doing a two-fold job. It's creating a toxicity problem or a potential health hazard, and it's at the same time creating an elimination of the species in the area which is being blanketed by this sludge. So we're losing ground on both aspects. It's become necessary for the safety of the consuming public to close an area around this dumpsite. This is a very significant area. It's better than 100 square miles involved. The fact that this has been done, I think, has served, and served well to bring this whole situation to the fore, and ultimately has resulted in our gathering here this evening.

At the same time we're here trying to solve this, the dumping goes on and the species is endangered because it is being blanketed and smothered basically. So, if we are able to bring together the thinking of the scientific community, some of whom you already heard speak, and the industry, whom you have yet to hear speak, and government people, of which I am the first this evening, together I think we can make a very meaningful inroad of stopping this kind of situation, and directing it to a better channel. Better in many respects. Better for the general usage of our waterways, including the Atlantic Ocean; better for any of the industries, which may be endangered by its continued use. And better for the advancement of general technology, because when we solve this problem, we're solving many, many problems. Only this one is our immediate attention. So, I think at this point I would like to leave those comments with you, and try and stimulate your interest in giving this whole project direction as to how we can next methodically make our move to stop the immediate problem of dumping, and to solve the long-range problem of what to do with this waste.

You've already heard said we can't stop generating this kind of waste. We are human, and it's part of our nature. But our problem is now where to put this or how to treat it, and this is where technology comes in. But there is going to be another gap. We're always having gaps—generation gaps—all kinds of gaps. This is going to be a gap between solving the technological problem and actually stopping this dumping that's going on now. We've got this interim period that we're concerned with, because that interim period is right now. So we're going to be very much concerned with how we can best serve ourselves and our industry in New Jersey during this interim period, while technology is trying to solve our problems. I think that's what we're here for.

Commissioner OSTRANDER. "We heard those folks speak from the standpoint of the ecological simulation of this problem and we in this area, especially myself, had no knowledge that these things were happening until a very short time ago. But there is a gentleman with us tonight, who has been doing something about it, and it appears that he is a very wonderful and splendid individual, and he's putting up a mighty battle against the Army Engineers, and perhaps he will help us to find some of the answers you and I are looking forward to finding. I'm speaking of Captain James L. Verber. Would he come up and disclose his thoughts please?"

CAPTAIN JAMES L. VERBER, USPHS, CHIEF NORTHEAST TECHNICAL SERVICE UNIT,
FOOD AND DRUG ADMINISTRATION

Thank you, Commissioner . . . Distinguished members at the head table and in the audience . . . it's a little difficult for me to know, Mr. Commissioner, where to start in speaking about this entire project tonight. Because the ocean dumping probably started ages ago, and really in 1925, when the first area was permitted off New York City, we had probably the establishment of the first recognized dumping area on the East Coast of the United States. This area was approximately 10 miles from Raritan Bay, just out from the Ambrose Light. It, too, is marked by a six-mile closure, the same as you have here off Delaware Bay. The area in New York receives at the present time approximately eight times the

amount of the sludge as the area now off Delaware Bay. With the advent of the City of Baltimore to the dumping scene in the Delaware area, this gap will close to about one to four. Baltimore proposes to dump about 100% more than what is now going out there.

The Food and Drug Administration, which has taken over the shellfish program approximately a year and a half ago, has proposed to maintain the safety of not only the surf clams, and the mahoganies, and the oysters and the clams—all of these to the shellfishing consuming public.

In my day-to-day routine, research-wise, I worked with Dr. Haskin at Rutgers. In my administrative capacity as working with the States, I'm working with Dick Bellis. Beyond that we have in-house studies, one of which, are the coastal waters of the United States, which lie beyond the jurisdiction of the individual states. That means beyond the three-mile limit. That's wherein the Federal Government comes to have problems. As you are probably aware, the Corps of Engineers has been the so-called (and I'll use that word so-called) evil in this particular aspect. A lot of thinking on my part, prior to this meeting today, has convinced me to some extent, that they may have been angels in disguise. Please let me explain. These areas, although they were selected without hydrographic knowledge, as indicated by Dr. Haskin, and perhaps, as Dr. Eble suggested, actually they were put offshore and the people who had the sludge, not only sludge now, let's also include the industrial waste. Let's include things like arsenic, cyanides, and a few other things. They were told to dump in the select outbound locations.

Perhaps forethought many years ago by someone in the Corps of Engineers, in the selection of these sites might have indicated that it was wise to pinpoint sites to put waste products, rather than to allow indiscriminate dumping. This may or may not have been the reasoning behind the Corps of Engineers. I'm inclined to think nowadays it was wise that we have these varied isolated and selected spots, because the industry today, I, speaking about the commercial industry, for using these dump sites, do have the right, complete right, under the law, off the coast of Delaware, to dump anywhere they wish beyond the three-mile limit. I want that to sink in.

A man with toxic waste and materials can go out beyond the three-mile limit and dump where he desires. The Corps of Engineers has enforced the utilization of these dump sites, which has kept this off of the general byways of the Continental Shelf. I don't mean to say that there hasn't been short dumping; I don't mean to say that some people haven't gone out there and dumped whatever they felt like—they have. But in general, they've tried to select these particular sites to maintain our wastes. Now this particular problem of dumping wastes on the Continental Shelf and the outline of it, by the way, I do wish to commend Captain Stocker on the printing of the Food and Drug Administration Map, and the notation for the signing up of people who are opposed to pollution. It's a wonderful thing. This is what we need as was suggested earlier, are people behind us in trying to enforce the stopping of pollution. I would not suggest for one minute the removal of the sludge from this particular area and dump it into the Delaware Bay or into any other waterway that might contain shellfish. Or, slightly further at sea, where you might possibly contaminate the shellfish which would become valuable ten years from now—twenty years from now. We have to be extremely careful on how we handle the relocation of these sites.

Dr. Haskin suggested earlier that based on the studies that he had gone over some 20 years ago, that there is a more feasible site to the south. Just a couple of years ago, we met with Dr. Haskin at Rutgers and went over in great detail this particular location to the south of the present area. It would prevent cross-contamination into the Delaware Bay, as he said, from the bottom sailing waters moving in, and prevent contamination from these bottom waters moving in into that area. But new things have come on the horizon. The Food and Drug Administration has been for sometime quite concerned about the problem of banning areas to shellfish. As you all know, we put out a product on the market today, and I'm speaking about the shellfish, which is 100% safe and dear. It's only because the Industry and the States and the Federal Government have been working together. It's a tremendous product. I've had no knowledge in my capacity working with the Federal Government of any problem with any type of shellfish through the past several years. And that's a tremendous credit to your industry. And that's a tremendous credit to the Program because it's working so well.

Your Better Government is taking steps now to try to control the problem on the Continental Shelf. This booklet was passed to me this afternoon. Our Regional Consultant in New York handed me the "Ocean Dumping—A National Policy", which is a report from the President, which was put out at the end of October. This will be one of the guiding principles for the organization called EPA—"The Environmental Protection Administration", which goes into full effect as of December, 1970. It was constituted into law on the second of October. The entire makeup of this organization will be controlled as of the second of December. The chairman of the Environmental Quality Administration proposes to the President, and this will be some of the guiding lines for the new organization which will control dumping at sea. I would like to read, please: "Ocean dumping of undigested sludge should be stopped as soon as possible, and no new sources allowed. Ocean dumping of digested or stabilized sludge should be phased out and no new source allowed". I believe I don't have to read any further, because in essence tells us what is to come.

I don't know what is going to happen in Baltimore. I haven't the slightest idea as to whether they'll be allowed to start it or not. It may be that we can't stop Baltimore from starting it. But EPA puts on a piece of paper that they are going to stop all sludge discharging at sea. Now, in terms of time, what are we speaking about with respect to the Continental Shelf? I would judge that in minimum, it will be from 10 to 15 years before we can stop all dumping at sea. It would be almost impossible to say that with less time span than that, you could stop cities like Philadelphia and New York from pulling back and disposing of their sludge by any other means. Short of this particular problem, we know it's going to continue now. We know, also, that better regulations for dumping at sea will be enforced by a federal agency—EPA. At that time, anybody who is discharging at sea, must have a license. We will have controlled discharge at sea. I don't know at the present time what type of surveillance will follow this controlled dumping.

Did you note, and I'm sure all of you have, the six-mile radius on this map, just out of my office? Why is it six miles from the dump area is only one by two? It's because of no surveillance of the dumping. Perhaps our northeast storms or other types of storms, where it is difficult to navigate out in the ocean, they may not even get to sea. We don't know. We have to protect the consumer. We have to protect the shellfish harvester, so that he knows he's getting a good product to put on the market. Therefore, in an area which has a fair safety zone, has been allocated, now with a new agency coming into being, if there are stringent surveillance methods by which the Food and Drug Administration can live with. To know that these barges are going out to their assigned locations, that particular area may get smaller. Under no consideration have we in the recent history, at least not as far as I know as of tonight, have proposed making this area larger. At the present time I have a whole team of men, right over the other side at Cape Henlopen area, making a second surveillance of this particular area.

Speaking about the Arthur Kill, we just came back from there a few weeks ago, where they dumped that stuff. I could go on about the Arthur Kill, but they should not have been allowed to be put in the ocean. The materials are detrimental. We are faced with the problem, gentlemen, of the materials going to sea for a period of time. I do request that we use all in your power to prevail upon the press in the various cities that are now dumping in the ocean, to turn to other means. They're going to have to in the near future, regardless. But as soon as the people in the cities realize how they are causing problems to your life, then they may also force their own cities to find new outlets.

In the meantime, the one thing we can do is to enforce surveillance, and that the dumping is put into the proper sites. Thank you for inviting me here, Mr. Commissioner. I appreciate it very much.

Commissioner OSTRANDER. Captain Verber was, I suspect, somewhat of a host, for the next person I'm going to call, and believe me, from the little knowledge that I have about her involvement in these problems, I would think, and I must say, she would be the most astute person, because I would guess that the paper work would be involved, which goes across her desk, qualifies her, perhaps in my opinion, more than most of us. She's a lovely, lovely lady, full of courage because she flew through the rain today with no qualms, and that takes courage. I'd like to call on Mrs. Libby Wallace.

MRS. ELIZABETH (LIBBY) WALLACE, DIRECTOR-SECRETARY, SHELLFISH INSTITUTE OF NORTH AMERICA

Thank you, Mr. Commissioner. Your hospitality, which included your royal red aerial carpet is superb. I've enjoyed every minute of it. The dinner is just great. It's wonderful to be with you.

We've brought with us, Bob Dorse from New York, who shares a comparable problem with you, in as much as he is the victim of the other dump site and by uniting our forces here in this Sea Clam business.

We do appreciate our host, Commissioner Ostrander, for having called this meeting, and the day I learned about it, by afternoon I was quite amused in as much as I thought you would be hosting the President himself, because Washington is so darn interested in this meeting, that I rather expected that you might have gotten inundated with people from the now Federal Water Pollution Control group, who are becoming EPA on Dec. 2, as Capt. Verber said.

We're so happy to be with you, Senator Bob Kay, who is a force for good here in your community; for Bill Kleb, of the Sea Clam Industry, and what Bill doesn't know about, either he forgot or it isn't worth knowing. And we all depend upon him to guide us in this industry. I'm delighted to be with my superiors in the academic field here, with whom we had the privilege, all of us, of working and in using their knowledge. I wish to commend each of you for your concern in being here to help solve this problem, and especially for those of you esteemed people among us who happen to be members of the Shellfish Institute. If any of you wants to join that group, would you believe that I have some applications here, and would be very happy to sign you up. Excuse the commercial, but please report to my presence, but I do try at every opportunity.

The trouble with this sludge site is that there are almost no redeeming features that we can think of except if you are from Philadelphia or Camden. As Dr. Haskin told you, it's in a wrong place. It appears that materials are barged down the Delaware to be swept back up into the already over-burdened bay. The discarded materials represent potential wealth and should not be wasted. They should be used. And this is enormously valuable material if we could handle it properly. And this is especially critical and sad since in disposing of it in the way it is done.

Approximately 120 square miles are closed to the harvest of sea clams and those clams are there. This is quite an assembly—the errors, the misjudgments and abuses. The heartening aspect of this particular meeting tonight is that it is so timely. You could hardly have picked a better time to rectify these wrongs. The entire notion is aroused and determined to put an end to the senseless abuse of our environment. High on the list is a preservation of our frail ocean.

We no longer delude ourselves that out of sight, out of mind, it's not hurting; it's not our responsibility. Our country is polluting the ocean to such an extent that other nations are calling an international conference this spring in Rome to examine the whole situation, and we must plead guilty to this abuse of that which belongs to everyone on the planet. The highest authority in our land President Nixon, has stated his determination to halt the degradation of the oceans. It's a booklet, which is a report of the Council on Environment Quality.

In the president's report he says: "The oceans, covering nearly three-quarters of the world's surface, are critical to the maintaining of our environment, for they contribute to the basic oxygen-carbon dioxide balance upon which human and animal life depends." This is in reference to the plankton in the ocean, the grasses of the sea that maintain this critical balance between the supply of carbon dioxide and oxygen. You know we say, "Have you thanked a tree today?" We had better say have you thanked the ocean, because it keeps this supply of oxygen available for us, and other living things to live. And we are rapidly, perhaps endangering the capacity of this planet to support our life. Never mind that we expect to go to the moon again in January. We have no plans to go there and live, so we'd better take pretty good care of this planet while we are here. Moreover, the vital processes of our planet are involved in a multitude of waste with the systems within this ocean, and we must take heed of them. Among the things the President says: "This study concludes that trends indicate that ocean disposal could become a major (he said nationwide environmental problem, but it isn't, it's a world-wide problem). Then another one: "Unless we begin now to develop alternative methods of disposing of these wastes, institutional and economic obstacles will make it extremely difficult to control ocean dumping in the future".

We're already aware of these crvaches that may make it almost impossible to change. But we must develop the alternatives. That the nation must act now, to keep the problem from reaching unmanageable proportions. This study, the one Jim Verber refers to, recommends legislation to ban the unregulated dumping of all the materials in the ocean, and to prevent or rigorously limit the dumping of harmful materials. The recommendation that legislation will call for permits by the administrator of the Environmental Protection Agency, for the transportation and dumping of all the materials in the ocean and in the Great Lakes. The President also says that he, himself, will see that this legislation is introduced into the new Congress for the first act of the duties of the Environmental Protection Agency.

Just last week, President Nixon appointed William D. Ruckelshaus, as the administrator for this new agency—EPA, or the Environmental Protection Agency. This agency comes into full bloom on December 2, having had a 60-day grace period for its organization.

A bit about the administrator. He is a 38-year-old attorney, and for less than one year has served as the assistant attorney general. Previously he served in the Indiana Legislature from 1966-69. Before this, he served in the Health Department and was the author of their air pollution laws. Meeting his responsibilities there, he prosecuted some polluters, and so rose to prominence.

EPA is an enforcement agency, and so it is natural that its administrator will be a lawyer, spearheading from the Department of Justice. It is well that he is young, because indeed, his tasks will be arduous. And it's well that he is from an inland state. You know, our Navy is made up from people from the inland states. Our problems are apt to be enthralling and a challenge to him. Let's help him meet the charge that President Nixon has just given him. It is quite appropriate, and I just mentioned this for reference to you, to request from him an enforcement conference on the basis that shellfish cannot be marketed because of pollution from this disposal area. The law already exists in 88234, which permits such an environmental enforcement conference on the environmental pollution. New Jersey need not feel at all ashamed that the Federal Government be invited into such a thing because, indeed, it is not in your coastal waters, and you are a victim of what others are doing to you. This disposal site in the Atlantic Ocean is being abused and so are our shores, and you are right, and not kidding yourselves that this isn't true. The conference will produce the kind of documentation that will be needed to rectify this disservice in the disposal area, which is a disservice to our industry, and to the total environment.

Commissioner OSTRANDER. There is one among us, who perhaps over the years has created a special kind of protection in law and order, in not only this particular county, but throughout this state. And I would like at this time to call on our Superior Court Judge A. J. Cafiero. Perhaps he has some words that may help to ring a bell or give us some direction towards solving the problem.

HON. A. J. CAFIERO, SUPERIOR COURT JUDGE, RETIRED

Thank you very much, Commissioner. I won't attempt to make any speeches regarding this problem. I'm aware of it, but I'm so pleased I was invited to come here, to listen to these people who do know something about it, and probably can offer some solution. I certainly want to commend you, particularly for bringing together this informed group of people, for the purpose of seeking a solution to this problem. It's a serious one, and it requires the understanding and attention of everyone. I certainly wish you God speed, and good luck.

Commissioner OSTRANDER. I kind of saved the last spot for not only a very, very wonderful person, but a concerned person, one whom I am sure will use whatever means in his power to try to rectify the situation we're confronted with. I'd like to call at this time, our Senator, Robert E. Kay.

SENATOR ROBERT E. KAY

Thank you, Commissioner and guests at the head table. These aren't speaking notes I have in front of me. The Commissioner asked me if I would read to you a couple of messages that were conveyed here this evening by interested persons

who could not be present. There are two communications from our U.S. Senator Harrison A. Williams, which the Commissioner asked that I relate to you. One is a letter Nov. 2, 1970, addressed to the Commissioner, which reads as follows:

"I wish to thank you for the strong interest you have shown in restoring and preserving the opportunity for area residents and visitors to use the waters of the Delaware Bay for commercial and recreational purposes. Your participation in the inspection trip to the dumping sites is a measure of your dedication in the cause of cleaning up the bay and keeping it clean. Be assured I shall continue to push for passage of S-3488, the National Marine Water Pollution Control and Qualities Enhancement Act, legislation I introduced to put a stop to the dumping of waste and sewage into waters such as the bay. It is my expectation that we will have success in the next Congress. I will most certainly reintroduce this legislation early next year and will continue to press for its enactment. I know I can continue to count on your support, with best wishes, sincerely, Harrison A. Williams, Jr."

That was followed by a telegram dated Nov. 10: "I regret that I cannot take part in tonight's meeting, to discuss with you a matter of deep concern to all of us. As all of you know, I have sponsored S-3488, a bill which, if enacted, would stop the dumping of wastes and sewage in the waterways. Specifically, in the Delaware Bay area. And I appreciate your interest and support for this measure. Let us continue to work hard in the months ahead to resolve this problem together with the Fishing and Shell Industry. With warm regards, Sincerely, Harrison A. Williams, Jr."

And in the second communication from our other U.S. Senator, Clifford B. Case, again with a dateline Nov. 10, 1970: "I regret that I am unable to be with you tonight, but I am looking forward to the opportunity to review the remarks of the many distinguished leaders in the field of oceanography and environmental protection who will be with you. As you know, the protection of our environment, and especially the environmental problems of our highly urbanized State have long been of deep concern to me. We are just beginning to realize the nature of the threat facing us. Until now man has considered himself a superior creature, not only intended to rule the earth, but privileged to alter his surroundings without regard to other species. Now we are becoming aware that man is part of a complex and interdependent system, that requires a delicate balance for survival. We must guard against these over-simplistic solutions to these complex problems. For example, many of our pollution control programs today are not really solutions, but merely attempts to pass on the problem to someone else farther down the stream, to foist the poisons of our immediate environment into our neighbors. It is my hope that you will look not only to the immediate solutions of your problems, but to the longer range protection of our total environment. Clifford B. Case, U.S. Senator."

Before I sit down, I might just make a couple of comments of my own. Perhaps I should heed the remarks of Bill Taylor who said "Only those should speak who know what they are talking about." But I would say this, as many of you know, some of you might not, I happen to be one of those individuals that has been a somewhat of a pleasure boater over many years . . . more than I like to think. In addition, I happen to reside, as many of you know, on the so-called back waters of Wildwood Crest. A tributary of what we call Sunset Lake area. My residence there is not of great duration. I moved there in 1961. I would be a little bit provincial, however, and a little bit critical when I think of this problem out in the bay-ocean complex, as we know it, and is shown on the map. We're all concerned about that problem, and I agree that is an extremely serious one. I agree I am a bit frustrated, and a bit discouraged tonight, when I have to, let's say hear it from the experts, that our real solution is 10 to 15 years away. And I would hope that something will happen which will actually, with the deepest of respect, contradict the good captain. I'm sure that he would agree with me, that he would like something to happen.

I think of a little story of what happened on my own boat. A very fine gentleman who is sitting in this room was on my boat with me one day. As you know on pleasure boats, historically over the years, when you use a head, anybody on the boat knows that you use it. When you turn it on, the noise is sufficient to tell you from one end of the boat to the other, someone's using the head. And this individual commented to me one day. He said, "You know, Bob, I don't understand it. We have the where-with-all and the know-how to put a man up on that moon with all of the things it takes to do it—yet nobody can figure out how to make a silent head."

It's kind of a likening here. We have this problem of dumping. The dumping comes from the need to get rid of the sludge and the waste. Certainly with the know-how in this country, it's just inconceivable to me that it's going to take 10 to 15 years of your life and mine, for the wonderful scientists that we have in this country, and in fact, sharing in the world, to come up with an answer to this problem. I just literally hope and pray that these scientists are given the where-with-all to work on this problem.

To get back to a little bit of a provincial comment: During the past summer I could stand on the back porch of my house and I could watch the commercial fishermen, the commercial boatmen (whose livelihood is dependent upon these waters) and I could watch the recreational boatmen as they went by my house, or within the line of my vision, to stand and sweep the trash and the dirt, yes, and sump the oil waste off their boats into the water. How can we say to the people in Philadelphia, "Don't send us your sludge," when we in our own back yard put into the waters of this area, maybe not the same sludge, but the dirt and the grease and the oil and everything which contaminates our waters. I've made complaints about this, and the authorities have pulled the boat people together, commercial and recreational, and they said: "Fellows, you've got to cut this out." I've seen this with my own eyes. It stops for about two weeks. It's like the antilitter campaigns—everybody gets all hepped up and say we won't throw any trash out of the car this week, but next week we won't worry about it.

So this is an educational process. It doesn't only go to Philadelphia; it doesn't only go to Baltimore; it doesn't only go to Bridgeton. I didn't realize that Bridgeton, a city in my own senatorial district, was involved in this, until I happened to see it in the newspaper headlines. So I learned something in this.

And again, I'm not being critical, I'm only saying that the problem isn't completely way up there, it's also down here. I like to think that over the years, individually, I've done what I could and urge my friends and my neighbors to keep just the plain pollutants out of the water. And I think I've made a little gain here and there. I've been out on the bay when there was an out-going tide and you can see a line of dirty water coming out of the Delaware Bay into the ocean—a line just as straight as that wall. Then you cross that line into water where you can see down two and three feet. And in my opinion it's not because a barge had dumped a lot of stuff the night before.

A few weeks ago I read in the *Bulletin* about some fellows who took a canoe trip, I believe all around the Susquehanna and the upper parts of the Delaware and around Philadelphia. They found the various industries and municipal plants dumping their filth and chemicals and every pollutant there is into the Delaware. And that comes down here. The problem is a big one and it's being attacked, fortunately, through the media of the press. I think the people are beginning to get a little excited. I have a deep concern for the economy of this county. It is in grave danger, in my opinion. I was born and raised here and the county has been good to me, and I try to do what I can for it. Like the others, I have to admit to you, I am frustrated and I don't know all of the answers.

I feel that somehow, with due respect to the Captain, somehow, somewhere there's got to be a speeding up of a solution to the problem, so that it doesn't take the time span mentioned, because by then I'm not sure that there'd be anybody fishing. I'm not sure there'd be anybody clamming. I'm not even sure that there'd be anybody swimming in the ocean off of Cape May, Wildwood Crest, Wildwood, North Wildwood, Stone Harbor, etc. And I think many of you feel the same. If any of you have the answers, come forward with them. All I can say is as your senator, and as my good colleague, Jimmy Casero said, anything we can do, we certainly will. We recognize the problem and the seriousness of it to each and every one of you. Thank you.

Commissioner OSTRANDER. I am especially delighted that this next person has requested to say a few words, because he represents the youth who will carry on when you and I have passed from this earth. I'd like to introduce Bill Maher, Jr.

WILLIAM J. MAHER, JR., IZAAK WALTON LEAGUE MEMBERSHIP CHAIRMAN

I'd like to reinforce what Senator Kay said in that things seem a little hopeless, and things seem a little frustrating because it is a challenge. It is open to people my age and certainly my children. These problems are going to be met by people of my generation and the younger generation. The only way these prob-

lems are going to be accomplished is through education. It's up to you people right here and out there, administratives, senators, etc., to open up doorways to give us an opportunity. As Senator Kay mentioned that after Earth Day it was a great big climax and then everything just snapped off. I think it was because people thought, "what can I do now? I've marched in Washington: I've screamed and yelled, threw a few rocks, etc."

I think it is the responsibility of you people here to open the pathways to utilize the energy of youth, because this is where the answer lies. I certainly hope that we can be instrumental in solving the problems that face us today. Thank you.

Commissioner OSTRANDER. There may be others among you who wish to come forward and have some words to say.

CARLO M. SARDELLA, PHILADELPHIA INQUIRER REPORTER

I'd like to ask a question of Captain Verber. I've been with this story for three weeks. I happen to live here and I'm just as interested as everyone else.

I don't have the benefit of reading the publications you're talking about as far as the power of this group is concerned. However, I spoke to officials of this new group in North Carolina. They are considering the application of Baltimore the second time. It's already been rejected once. It was once approved and then rejected. Now I am told by Mr. Hasburger, who is in charge of Baltimore Operations, and he tells me that their completely digested sludge will approximate 90% of Philadelphia's. There is nothing, even in this new organization, and in this new policy that is going to prevent them from dumping in this area—accept one thing—and that's money. This new group has all the power to give federal funds to help in barging. The man in charge of the operation told me that this policy is against open barging as far as he is concerned. I quote: "We cannot prevent the City of Baltimore from dumping, we can only withhold funds". Mr. Hasburger tells me the reason why the site was selected was because Philadelphia picked it, and they took advantage of Philadelphia's engineering. Incidentally, Bridgeton's sludge is completely undigested—not one bit digested. Camden is only 25% digested and mentioned that sea water will take care of the rest.

Getting back to Baltimore, Mr. Hasburger tells me they intend to start dumping before January 1—if they do not get approval, which means federal funds. Captain, I ask you to answer some of those points, and I also would like to recommend to the group as an amateur ecologist of the area, that petitions be directed to the Federal Government to prevent Baltimore from getting funds might help.

Captain VERBER. Thank you, Carlo. I think it will take me six months to answer the letters at my headquarters pertaining to your article that appeared this morning. Nevertheless, the article I was referring to, and that Mrs. Wallace referred to was the report to the President by Commissioner Train—Council on Environmental Quality. These recommendations are proposed to the next Congress to go into law, to be the governing background of the new organization. As I read, it is now going to be the policy of the Federal Government to prevent all sludge, whether digested or undigested, to be dumped at sea. I wish I could give you some indication of what 90% means when you talk about the City of Baltimore. (A million people, 90%—10% of one million.) That means the waste products of one hundred thousand people are going to be dumped in raw if they only accomplish 90%.

CARLO SARDELLA. Captain, the \$68 question: How can this group prevent dumping beyond the three-mile limit?

Captain VERBER. There is no law on the books to prevent it at the present time—none whatsoever. To withhold Federal funds for the disposal at sea, the only thing you can do is to write letters to the Federal Water Quality Administration, which is probably the administration which would handle funds for dumping, or address them to the new Environmental Protection Agency, to Mr. Ruckelshaus, who is the new administrator. This is your new environmental protection association for land-water and sea.

Our specific purpose tonight is the ocean dumping. We have enforcement agencies and this is why they were created. This does not negate the work of the Food and Drug Administration within the problems of sanitation and public health. But this is to prevent wholesale pollution at sea. And this is the work they will be involved in.

Referring to Baltimore and to my 10-to-15-year prediction, I wish to say how do you stop a city that is snow-balling along, and has geared themselves, and has been gearing themselves towards this type of disposal? It can't be done, of course. It's difficult. Take New York City with its four billion gallons of waste per year—do you know what that means? Thirty-seven million gallons of oil has been spilled in our open oceans. Philadelphia, New York City and its environs are dumping almost that amount every day, along with sludge. You're talking about the magnitude of the problem that you have to convert the complex of cities like this. You ask if technology is available. Chicago doesn't dump in Lake Michigan, nor does it dump its sludge into the Chicago River. The technology of, or types of technology are available. The problem is that it costs money. Are we willing to foot the bill? The type of money we're talking about is that used to put a man on the moon. But it will save your total environment, and before we're through we're going to have to appropriate these funds. This is what we're really keying down to: Are we, along with our legislative and senate bodies, on behalf of my constituents, willing to put forth the billions of dollars? The Senator here tonight is one who is deeply involved in the program. He knows the problems; he sees it at his back door. He'll work for it, and he'll fight for it. This is the type of thing we have to put up with. I don't know if I answered all of your questions, Carlo, but I tried. Thanks.

Commissioner OSTRANDER. We have with us another gentleman, I am sure has become somewhat frustrated in his attempts to control, or eliminate, or inform, and he is a direct representation of the shell-fishing industry, and knows, perhaps both sides of the story, insofar as harvesting of clams and shellfish, and also the problem on pollution. I'd like to call Bill Kleb to the microphone.

WILLIAM J. KLEB, CHAIRMAN, SEA CLAM PACKERS ASSOCIATION

Thank you, Commissioner. Although retired, my title still in force is Chairman of the Eastern Sea Clam Packers Association, which represents all of the surf clam packers in this area in good standing, who in turn belong to the Shellfish Institute of North America—not all, but mostly.

I think the questions the industry was interested in asking was answered by Captain Verber. All Industry can say now, and I believe this goes for everyone who operates boats catching clams, that when this law goes into effect, and dumping is done on target, it will close this area up, and we as the Industry, will abide by your restrictions and your restricted area. I think we will have to do without this area, and it's not going to put us out of business. I think this is the best news we have heard in the last five years. I've been to quite a few meetings with Mrs. Wallace and also Captain Verber, and this is the best I've heard at this time. Thank you.

Commissioner OSTRANDER. I think in all justification I'd like to mention those who helped put this program together. I'd like to announce some of their names because they worked rather hard: Tom Grooket, Richard Gessler, Richard Harmon, Eleanor Hughes, and Mrs. Richard Harmon. The reason for having you fill out cards this evening is so we can forward to you a copy of the transcript of this evening's proceedings.

I would like to thank Otto Stocker for doing an outstanding job in his field. Mr. Stocker, I understand had 5000 papers delivered throughout the school districts along the Atlantic seaboard. Along with that, there were petitions circulated, and I have to admit, they were consummated by my personal being. We have over 22,000 names of protest that will be delivered at an appropriate time to proper authorities in Washington. The people in Cape May, Cumberland, and Atlantic Counties are disturbed and perhaps will indicate to Washington our desires to find answers of importance to maintain the ecology of these communities. It goes beyond just the shellfishing industry, and we've talked about shellfishing and the pollution of the waters. But believe me, there's multi-millions of dollars involved, not only in the oceans, but along our shorelines, along with the seasonal business of motels and enterprises that directly effect our communities. These things need to be protected along with the shellfishing industry. It is not inconceivable in my mind, and many minds, that a good northeastern storm at the wrong time of the year could land a good percentage of waste materials up on the beaches. And lo and behold, if this should happen, we would really experience trouble.

**CAPTAIN OTTO STOCKER, CAPE MAY COUNTY PARTY BOAT ASSOCIATION
AND SPORTSMAN'S ASSOCIATION**

I'd like to comment on something. You know I am a little bit disappointed, and there's quite a few of us here who are also. I'm going to be a little bit diplomatic. I was a little bit surprised when I asked a congressman if he knew anything about this and he replied no. I wonder who is running the country? I know from many men around this water that we depend on the men we put into office to be on the ball, and he's expected to know what goes on. Mr. Ostrander, this young man here and myself contacted you, and you were able and had guts enough to get this whole group together. I'm putting it flat on the table.

We have a fishing industry here. The Army Engineers allowed this dumping area to be put out here, and at great expense. Men have been earning their living here for 40 years and now they are told to go away. Materials are dumped before the barge gets any where near the bay. There should be an authority on the boat. There is no supervision whatsoever. They don't dump it when the tide is going out, they dump it when the tide is coming in. When nothing shows on radar, they dump.

We have an area located where the bottom is low, and where there is life and permission is given to dump right on the life. Orders are given not to take the wastes further out. The Continental Shelf is plenty deep. Where we have 50 or 60 feet of water, we have sluices which go down 40 or 50 feet. The wastes will never get out of there. It will stay for years, if it is taken to the Continental Shelf. Even though there is a little life at the Shelf, here is no where near the amount that has already been destroyed in this area.

We lack the supervision. Action should be taken now, and it can be taken now. When we sunk seven boats out in the ocean to make for better fishing, we had an army engineer and a biologist on board. But there is not a damn one of those boats to police the dumping. This doesn't have to be. It's negligent operation of government forces, and I know that's pretty strong language. How can this be stopped? I'll tell you how this can be stopped—a large group of people protesting in Washington can help stop a movement. There's enough voting people right now, and they're burning. If a tug doesn't know how to get out to the ocean, we can escort them 70 miles off, and by the time he gets back, he won't want to drink a cup of water. That's what it's getting to be. That sounds vicious, but we have to have people with guts.

I'm going to excite every school kid up and down this coast, and they're going to put the blame on whoever it belongs to. I'm surprised that the people we vote in office don't know the first damn thing about this. Mr. Ostrander was the only one who took hold of this thing. I have asked many people up and down the coast and the municipalities didn't know this was being dumped. We should know about it. But, no, the Army Engineers have never been stopped.

There should be an order stating that an inspector be on a barge, particularly one who knows the waters and currents, rather than a scientific-minded person. The fishing areas are spoiled, and life is being destroyed. If they keep on dumping, it will get worse.

Gentlemen, this is my opinion and also the opinion of many of the small people. If we don't get action quick, then we'll have to get protection for ourselves. This has gone to extremes. We gave the younger generation a garbage pail and told them to go ahead and clean it up. It's not their duty, it's ours. I hope this time we can do something about this mess.

Commissioner OSTRANDER. Captain Verber would like to have a few words in reference to those comments.

Captain JAMES VERBER. And it's not a rebuttal, it's an agreement. I wish to relate something that happened starting late in March of this year. Nobody is more concerned than I for putting an inspector on a barge. I have been advocating this, more so in the New York area than here, because the magnitude is greater in that area. I went to the Corps of Engineers and asked that problems be taken care of because we believe that short dumping was occurring. The problem they said to me was: "You tell me the man who was short dumping and we'll remove his license". You see the position this puts me in immediately. I'm a servant of you people, I'm trying to do the job for you. I work for this fishing association out here. I'm part of the national shellfish sanitation program. I have to go out with a team and prove that there was indeed sludge being dumped short of the proposed site, and it took quite a bit of time.

Because of the action we took and the information we gave to the Corps of Engineers, the particular sludge barge, which was going out of the inlet, had an inspector on board. He now rides on board every time the barge goes out. This expense is paid by the State of New York. The Corps of Engineers do not have the funds to pay for putting men on barges.

The same now applies to Philadelphia. Nobody would be more happier to see this stuff being very selectively dumped than myself. But you say possibly put it in the Canyon. I raise a question. Yes, I agree that many miles at sea, at the edge of the Continental Shelf, at the present time appears to be a much better site than the present location. The area in New York was considered and also the head of the Hudson Canyon, as a possible dump site by the State of New Jersey. They proposed to the Corps of Engineers that they were going to stop all of the boats coming out of Northern New Jersey and go either into deeper water or possibly into the Canyon. It was then that we found out that the giant lobster, commercial species of red crabs, to great numbers exist and grow at the head of the Canyon. So we have to be careful about the site that is selected for the dumping, until we can clean up the whole mess.

I can't agree with you more. If you can let me help you to disseminate more of the literature you have, not only to the school children of New Jersey, but to people in every other coastal state, we're going to be better off and faster. Thank you.

Commissioner OSTRANDER. There was another person working on this committee and I certainly would not wish to forget to mention his name, because he did a splendid job in our behalf. He is Harry Clunn. Forgive me if I have not mentioned those who are of special consideration or people who would wish to participate in our thoughts. This was to be an informative type of dinner. I believe those things have come forward to your liking, and maybe we're gradually going to be able to find an answer to these problems.

I am most happy with the reports that were made and I'm sure a possible constant follow-through week after week, with petitions and with every other media, such as newspapers, television and radio, and also the approach to our senators and our congressmen and all of those on the state level. We hope action will be taken quickly enough to create a survival for our area especially.

MERVIN KENT, EDITOR, CAPE MAY COUNTY GAZETTE

MERVIN KENT. Mr. Chairman, to crystallize some action on what has been said here tonight, may I propose that while this group is here that a preparation of a resolution be signed and directed to the new EPA, protesting vigorously that a permit to the City of Baltimore if it should add any more to our problems?

Commissioner OSTRANDER. Mr. Kent, that is a splendid idea. Actually I don't suspect that we have a formal group inasmuch as officers, but perhaps through our splendid Mrs. Wallace those projections can take place and she will have all the details, and I'm sure that she is interested enough to create the follow-through. I don't think any motions are necessary, but I'm sure everyone here would appreciate being involved in that consideration.

MERVIN KENT. Might I ask one question? Would everybody here, or most of the people here object to their names being signed to a vigorous letter of protest to the EPA? Would that be permissible?

Commissioner OSTRANDER. I don't see why not. As I indicated awhile ago, a transcript will be sent to all of the folks in attendance. It will take in review those happenings this evening, and perhaps along with that we can send a personal petition as you might call it. Maybe that's the word, I don't know.

That they would be willing to sign would create a certain representative situation as far as this particular meeting is concerned, and I believe that can happen. I don't know whether anyone would protest, but I'm sure they wouldn't, because they're interested enough to be here this evening.

RICHARD E. BELLIS. In my opening remarks I mentioned that we were going to assume a little direction tonight. I think we have definitely done this. We can see what's in store ahead at the federal level. At least we can get some idea. But we don't have the nitty-gritty of what's going to happen. One of the things we found out is that there is going to be the technique of issuing permits. I don't think we can go home from here tonight and breathe a sigh of relief and say

"Oh, my gosh, our worries are over," because we're going to have to watch very, very closely what kind of permits are issued, and where they're going to be issued for.

I think the Industry has taken the position of saying this is the best news we've heard. This is true. But we still have a long way to go. These permits are the next kind of step that we've got to be aware of. And certainly our wishes here have got to be the most influential in the country as far as the Sea Otter Industry is concerned, because we are the heart of it. So now I think we are in the position to take a real leadership role in making our wants known to the Federal Government. This is in no way detrimental to what is going to happen at the Federal level. It's just that we should be influencing what their direction should be. Thank you.

WILLIAM R. RIGLING, REPRESENTATIVE, MALTER INTERNATIONAL CORP.

Commissioner Ostrander, I'm new to the area. I'm here since the First of October. I represent Malter International. We're a research and development company.

My eyes have been opened here tonight. I'll be on the phone tomorrow talking to our research lab in New Orleans. I will see what kind of strides they've made in the disposal of sludge chemically, which can be done. I don't think there's any reason why it can't, and they in turn contact the various municipalities to work with them to try and help solve this problem. I am very pleased with the turnout here. The people here are tremendous. We have a common goal. I'm going to live here a long, long time, and if there's any way I can help you, I'd be glad to do so. Thank you.

Commissioner OSTRANDER. May I interject one other thought? It is my understanding that Mrs. Wallace is the Director of the Shellfish Institute of North America. Some of you boys in this particular area may not hold membership in that group. It seems that an organization among yourselves is sorely needed, and also a committee created in such a nature for a direct follow-through to the senate or to Washington pertaining to your proposals or considerations.

So tonight does not become a condition whereby we just listened, I believe the Industry itself should create a strong committee, so that a follow-through should and can take place from this day forward.

Mayor Charles Masciarella of Wildwood has interjected his thoughts in my behalf to do whatever we can in the City of Wildwood, and help you do the things that are necessary. The mayors of the other communities are well-informed and will be delighted to help. I believe it is somewhat your responsibility and your business in a sense in protecting the industry that you are involved with. If you don't have a committee, there should be a representation of each of those organizations, formed immediately so that these things can be funnelled in to you from time to time so that you may take the necessary action. We will help. I'm sure everyone here will help.

Thank you very, very much for attending. It's been wonderful, and we appreciate it. Maybe through this we may be able to find answers to other parts of the country by meetings of this nature. Thank you very, very much.

We have provided a list of the following for those who wish further contact: Commissioner Wilbur J. Ostrander, Presiding Officer, Moderator, Wildwood City Hall, Wildwood, N.J. 08260.

Dr. Harold H. Haskin, New Jersey Shellfish Research, Department of Zoology, Rutgers University, New Brunswick, N.J.

Dr. Albert F. Eble, Trenton State College, N.J. Marine Sciences Consortium, R.D. No. 5, Flemington, N.J.

Dr. James B. Ridlon, New Jersey Marine Sciences, Consortium, 1210 Wood-Lynne Boulevard, Linwood, N.J. 08221.

William E. Waters, Natural Resources Council, Department of Environmental Protection, 1621 S. Shore Road, Palmyra, N.J.

Richard E. Bellis, New Jersey State Department of Environmental Protection, 125 Susan Drive, Trenton, N.J.

Captain James L. Verber, USPHS, Chief Northeast Technical Service Unit, Food and Drug Administration, CBC, USN, Davisville, R.I. 02852.

Mrs. Elizabeth Wallace, Director, Shellfish Institute of North America, 22 Main Street, Sayville, N.Y. 11782.

List of persons who participated in taking a boat trip to dumping site off the New Jersey coast, about 14 miles out in the Atlantic, from the mouth of the Delaware Bay, on February 28, 1971.

Dr. Gordon F. MacDonald, Member, President's Council on Environmental Quality.

David Dominick, head of the Federal Water Pollution Control Agency.

Mrs. Jayne Drumley, Council on Environmental Quality, Information Officer.

Barry Berth, Environmental Protection Agency.

Richard E. Bellis, New Jersey Department of EPA.

George A. Nilson, Fish Products Co., Lewes, Del. (Menhaden Industry).

Robert H. Nicholson, Mgr. Doxee Clam Co., Lewes, Del.

Richard T. Dewling, Director of Research, Edison Water Quality Lab. EPA, Edison, N.J.

Salvatore LaMonica, Cape May Cannery, Cape May, N.J.

George Post, Cape May Court House, N.J., former Freeholder.

Harry E. Derrickson, Representative, State of Delaware.

Mayor Charles Masciarella, City of Wildwood, N.J.

Clarence Shoffler, Clam boat operator.

Eirik Kirkeberg, Clam boat owner-operator.

Donald Long, Wildwood Clam Co., owner.

Commissioner Wilbur J. Ostrander, president, S.O.D.A., City of Wildwood, N.J.

Wolf Dollman, WFIL-TV, Philadelphia, Penna.

Herb Clark, WCAU-TV, Philadelphia, Penna.

KYW-TV newsmen.

Per Otto Erichsen, reporter, Philadelphia Bulletin.

Roberta Hornig, reporter, Washington Star.

David Bird, New York Times.

J. Mazzotta, UPI.

Dick Uts, UPI, Atlantic City Press, Atlantic City, N.J.

Alex MacGregor, Cape May Court House, N.J. Middle Twp. Taxpayers Association.

Jerry LaBelle, AP.

Jack Weigang, Atlantic City Press.

Tom Kinnernand, photographer, Atlantic City Press.

Art Merrill, National Marine Fishery Service (Director N.O.A.A.) Oxford, Md.

Allan Backer, Del Haven, N.J., Fishery Biologist in N.O.A.A.

Carlo Sardella, Philadelphia Inquirer.

Jim Staples, Newark News.

Wally Judd, Ecology Reporter, Wilmington (Del.) News Journal.

Bob Frump, reporter, Wilmington News Journal.

Mervin Kent, editor, Cape May County Gazette (Cape May Court House, N.J.)

STOP OCEAN DUMPING ASSOCIATION (SODA)

MEETING HELD IN WILDWOOD CITY HALL JANUARY 14, 1971

Principal speakers:

Charles Masciarella, Mayor, City of Wildwood, N.J.

Joseph Von Lavage, Mayor, Borough of Wildwood Crest, N.J.

Carmen F. Guarino, Deputy Commissioner, Water Department, Water Pollution Control, City of Philadelphia, Pa.

Angelo Errichetti, Director of Public Works, City of Camden, N.J.

Senator Robert E. Kay, Wildwood Crest, N.J.

Senator Thomas E. Hickman, Jr., (Sussex County) Del.

Congressman Harry E. Derrickson, Rehoboth Beach, Del.

Austin N. Heller, Secretary, Dept. of Natural Resources & Environmental Control, Dover, Del.

Assemblyman James Caffero, North Wildwood, N.J.

Commissioner Wilbur J. Ostrander, Dept. of Public Works, City of Wildwood, President, SODA.

Fred Coldren, A representative from Congressman Charles W. Sandman's office, Second Congressional District, State of New Jersey.

Captain Otto Stocker, Cape May County Party Boat and Sportsmen's Association, Wildwood Crest, N.J., Treasurer of SODA.

Anthony J. Bianchi, President, Greater Wildwood Hotel-Motel Association,
Second Vice President, SODA.

Joseph E. Olwell, Executive Director, SODA, North Wildwood, N.J.

Robert Hentges, Mayor, West Wildwood, N.J.

Dr. Stanley Hornstine, Department of Public Health, City of Wildwood, N.J.

Mayor MASCIARELLA. I would like to, on behalf of the City of Wildwood, express our gratitude to all of you for coming to this meeting and hope that we may arrive at some recommendations and some suggestions from the officials that would help our resort and help our fishing and clamming industry in the South Jersey area.

I think most of you realize and know that as a resort, the economy we have here is fishing and clamming and renting of rooms. We do not have any heavy industry for our economy, the only industry we have here is resort business. Fishing and clamming is so very pertinent to all of us that live in this community, and important that we must try to preserve what we have and the economy that we live by, so that we, the Commissioners of the City of Wildwood and the committee that has been formed to prevent ocean dumping, that has been very detrimental to our economy would like to have help from other communities, and we would like to have information from other communities and get involved for the best interest of the state and the best interest of the pollution of the ocean. I feel that we are risking the future of our economy, unless something is done immediately and some drastic action of some nature taken with force, for the many people involved. I think many of us know who is really responsible. I think it has been pushed around from one department to the other up to this point. Of course the federal government is involved, and it seems to be that we are in the midst of confusion of who is really responsible, and maybe from this meeting the knowledge that will come from some of the officials might increase some of the knowledge that we have. It might be of some help to all of us. I understand that Mayor Von Savage, one of the officials on the committee is to conduct this meeting and I would like to turn the meeting over to Mayor Von Savage.

Mayor VON SAVAGE. Thank you Mayor Masciarella. Before we begin the meeting I would like to introduce the men at the head table, starting from my left, the head of this organization of association who is, and a man who has been spearheading this project, Wilbur Ostrander, Commissioner of Wildwood, next is the Mayor of North Wildwood, Tony Catanoso, to my extreme right there is the Mayor of West Wildwood Mayor Hentges, next the Commissioner of Public Safety for Wildwood, Commissioner Dr. Joseph Furey. I was hoping that the people I contacted all would have been present, however there is one disappointment, and that is from Mayor Aikens office of Bridgeton, who is confronted with a series of problems, Urban renewal meeting called by Federal, and he had no way of getting out or sending anyone down, only perhaps the Captain or Chief of Police, and he thought that wasn't necessary, however this morning and he related to me there plans and what they intended to do and I will say this he was very sincere and very concerned of the problem, and to some degree a certain amount of embarrassment that they had to dispose of their waste in this manner. I will call on the other representatives from the community, before I do so I would like to give you his report, he asked me if I would do this for this group. Now, they have engaged an outfit from Merchantville who are consultants concerning disposal plants and sewage discharge, now they do have this on the planning board and they are concerned about a disposal plant due Cumberland County, he tells me they would like to have the bids out, the project is supposed to cost in the neighborhood of 5.5 million dollars, he thought it would be ready for bids sometime late March or April.

Now, between now and the time of completion of the disposal plant, they have a feasibility study going on to study as to how to dispose of it before completion of the disposal plant, the thought runs through their mind that they have a large area, vacant land, and they thought they could discharge it there and chemically treat it, and through this process let it evaporate, whether this is possible or not he didn't know, but this is one of the avenues they are traveling on in order to eliminate dumping in the ocean. To begin with it is a costly proposition in the neighborhood of a \$100,000 to \$150,000 on an annual basis, which they want to get away from. He did mention to me that his concern is that he has a property in Ocean City for the past thirty years and he would like to see our beaches and

our area free of any waste that would be floating in the area. Now that was his report, and as I say, and they are watching the news releases and they will continue working on this until they reach a satisfactory agreement. I would like to at this time to introduce a representative who has traveled down this morning from the City of Philadelphia, he is a Mr. Carmen Guarino from Philadelphia, representing the City of Philadelphia, Carmen if you would care to relate to us your thoughts or the City's thoughts as to their future plans, we would certainly appreciate it. Mr. Guarino.

CARMEN GUARINO. Well this is such a large project and we could talk for many hours, so I am going to try to get the key points and we can enlarge on these things as we go along, but as far as Philadelphia is concerned, you must realize that we conducted a study back in 1958 and based on this study, 14 different plans were considered, we derived at that time that the most practical way to dispose of our digested sludge was by barging it to sea. Now I can only speak for Philadelphia, as to our method and the type of sludge we are disposing. Now per chance you don't know, I am talking about a sludge, 0123 to 0125 not recorded—Chicago, right today is screening out one of their large lagoons, and they are taking this material and depositing it on land and this I understand increases the yield of corn something like 48 bu. an acre, so here you have a case where this digested sludge is available, and evidently it isn't doing any harm at all, instead it is increasing the yield of the land, so we say here we are we're transporting a much smaller quantity of digested sludge than you see quoted in the paper to a cavern in the ocean floor, which may be as far as we know helpful to the environment, at this stage of the game no one has come out so far and said that digested sludge is not a method of re-cycling the waste back into the environment, that gives you a little bit of background, now the latest report I have from the U.S. Public Health and I've got it right here in my file, when they've done bacterial analysis in the disposal area that we are using the bacterial count is very low, something like 3 per 100 cc. And so we're concerned about the problem because we're engineers and we don't have any intention of unloading problems on anyone else. No that is not the intention at all, the intention is to dispose of waste is a problem for any community, and we have nothing to gain by hurting anyone else and as far as we know this is a practical solution, but be that as it may we have a contract with the Franklin Institute, which is a reputable agency and we've asked them to conduct a study of this area, and this study will conclude and determine the predominant ocean current they will do pathological studies and it will be done by the bacteriologist at the Jefferson Hospital, and we hope that legislation is not pushed too fast.

You know we see this happening right along where the total of these things is put in such a way, they feel that someone is going out of their way to harm other people but, look at the recent detergent situation, where they passed legislation to ban phosphates and replace it with NTA, only to find out several months later NTA was worse than the phosphates, so now they turn around and they are banning NTA. So not to take up too much of your time here at this meeting, so at this time we are going to continue our program, but in the meantime we can investigate and see whether or just what the sludge is doing in that unloading area. Thank you.

MAYOR MASCIARELLA. Before we continue I would like to make a suggestion that would help each one of us, so we would get to know each other a little better, the press also, if each one of us would stand and identify ourselves, for the record and for our own familiarity, if each one would stand and give their name and title, this would be much appreciated. (At this time each person stood and gave their name and title.)

MAYOR VON SAVAGE. Thank you, Mayor, for the idea of introducing everyone. At this time I would like to call on Angelo Errichetti of Camden, representing Mayor Nardi, Mr. Errichetti.

ANGELO ERRICHETTI. Thank you, Mayor. In my humble opinion, and I say this very sincerely and very honestly, I think that it is time to stop talking, and time for action, and I think regardless whether Camden dumps in the ocean, or Wildwood dumps in the bay, it has got to be stopped, it has got to be stopped immediately, in my opinion The City of Camden is ready and we are finished planning, and we are finished studying, we are ready for action, we have formed an Authority, of which we will be completed by 1974, we will stop dumping, whether it is wrong or right, whether you can prove there is benefit, or no benefit to it, we must protect our environment, whether it is land, or whether it be water,

it is time everyone gets together, starts working together in solving the problem, instead of just talking about it. I have heard a lot of talk about it, a lot of publicity about it, that must stop, I would suggest you gentlemen get behind your representatives, whether it be your State Assemblyman or whether it be your State Senator, or whether it be Charlie Sandman, or whether it be Bill Cahill. Stop it now. Time limit, legislation for everyone, from Washington, D.C., to stop dumping, whether it's in the bays, waters, the Delaware River or whether it's the ocean. And I say a time limit, a feasible time limit, 3 years, two years, four years, five years, put a time limit to stop it, now before we lose all of our ecology, and all of our environment, forget about Wildwood, forget about Atlantic City, this is your livelihood, tourism, and if we destroy that particular end of it, I think you destroy a business. Camden is ready, willing, and able to stop, we have plans ready for specification, ready to go, the State Department of Environmental Control has helped a great deal. Mr. Asselta's office has been on our back, thank heaven he has. I hope that other people take this same lead and start working towards solving the problem, rather than having meeting after meeting. It's time to pull everyone together, and start doing a job, instead of just talking about it. The word is action really, action now. Thank you.

Mayor VON SAVAGE. Thank you very much. When I spoke to Senator Kay and Assemblyman Caffero a few minutes ago, they informed me they were involved in a very important meeting and asked if they would be too long, so we will get you in and get you out as soon as we can. And I thought I would call on our Senator Kay, for him to speak on the Ocean dumping, and maybe he may have a word or two concerning this problem. At this time I would like to present to you, Senator Robert E. Key, representing Cumberland and Cape May Counties.

Senator KAY. Thank you Mayor, as the Mayor has indicated to you, and due partially to being in session on Tuesday, I didn't know of this meeting until yesterday morning. I had called the Commissioners office this morning and said that I really couldn't be here because of one other meeting, but the Assemblyman and I felt that if our presence was of some meaningful importance here this morning, we would be glad to stop down. I think probably because of my legal background, for those of you who might not know of course I am a lawyer. And this problem, and I might say ever since I've known anything about it, and I might say it was really brought to my attention back some months ago now by my good friend and neighbor Ot Stocker. Who became aware of it, particularly in the area which has already been closed, and of course unfortunately it takes some kind of action like that to wake some of us up. We know things go on and so forth but until some drastic action takes place, we very frankly are very prone to keep our back turned to it. But, as I started to say due to my legal background the frustrating part has been to me constantly, how do you control those areas that are outside of what I would refer to as the jurisdictional limits. Now I have seen various programs advance concerning the question of permits to be issued, I think of course this is a possibility, but of course we get back to the policing problem and those of you who may have been, and I think some of you were, at the Lobster House, back now again some months ago, if I remember one of the Coast Guard officials contended that they were endeavoring to do a bit of policing in the New York area and I think he mentioned somewhat in this area. But as I remember his comments, one of their problems was very frankly a lack of sufficient, adequate trained personnel to do the policing. You know it's really easy, and I say this with and in a respectful way, at the State or Federal level to pass a law, and say don't do this or don't do that, that of course leads you into the policing problem. So that I'm fully aware, at least I believe I am of the Seriousness of the problem. Particularly since, here is an area out in our ocean, out off of Cape May Point, that I would have said back maybe a year ago well it doesn't make any difference what you put in there.

You'll never pollute that much water enough to destroy sea life, and yet there is evidence today, the fact that sea life can be destroyed, it can be practically eliminated, if we allow the indiscriminate continual polluting of the water. Now I might just comment from the Lobster House, one of the problems you run into when you get together with experts, and I've heard it said for instance, well we ought to dump at, whatever has to be dumped, dump it at the continental shelf. Roughly 60 or 70 miles off. And I heard another expert say, oh no don't dump it at the shelf, you are going to create problems there. Actually I suppose 100 miles at sea, I haven't heard anyone yet say, don't dump it 100 miles at sea. Although in the long range, maybe beyond the lifetime

of any of us, even 100 miles at sea is not the answer. So that I might say when I talked with Mr. Stocker after the visit that he and Commissioner Ostrander made to Pennsylvania, the end of last week and I was amazed at the things I found out about these things in Pennsylvania, which I'm not sure whether it's on its way down here yet or not. Again this week due to the session of the legislature and so forth, I had to just get what I could from the newspapers about the present current situation. I note that the organization ran into a problem so to speak when they consulted legal counsel on it from an injunction standpoint, where do you go to stop something like this, when again there is no jurisdiction this is the problem, and I don't know the answer, I may be a State Senator, I may be a lawyer, but I don't know the answer, it's going to take a lot of heads put together, but also it's going to take a lot of action and this group that has been formed here locally, this Stop Ocean Dumping Association, the kind of attention that that association can bring because somehow or other you have got to build up a resistance among the public. And make them aware and certainly the SODA has been endeavoring to do that, and I know to the best of their ability. I don't have the answers, but I can only say this, that in any given way at all if there is anyone in this State whether he is at the governmental level, including the Governor, who can help, and sometimes I wonder if there ought to be some kind of contact through the Governor of New Jersey to the Governor of Pennsylvania, I'm speaking primarily now about that material that is up in the Pottstown, or Pottsville area where ever it is, and I can only say to you I'm perfectly willing at any time to go to the Governor of this State, and say Governor we've got to have some help from you, not just newspaper release, but some actual over help. And I know that my Assemblymen, in fact both of them, Jim Hurly and Jim Caffero, would be with me 100 percent on anything of that kind.

The problem when I get over to the legal side is, exactly what to do that is going to be meaningful, now I'm glad to hear the Camden delegate so to speak, talk as he does, because apparently they are aware of the situation, now I just spoke briefly with Mayor Von Savage and he tells me that he had a message from the Mayor of Bridgeton, Mayor Aiken, and of course Bridgeton is in my own district, so lets say the District I represent in the Senate, and I am happy to hear that Bridgeton is moving in the proper direction. Unfortunately, it is the type of thing where you just can't stop it like on 24 hours notice, but it takes programming, it takes exerted effort to at least get people aware of what is going on, so that perhaps by, this is 1971, by 1974 or 1975, we could look at each other and say well those efforts that we put forth back in 1970 or 1971, and those people who put together the SODA, it became effective, and we now have stopped destroying those things which of themselves could destroy our economy here in Cape May County. And I don't think it is limited just to Cape May County it's a lot broader than that, the ecology of today is that we've just got to stop using the waters of our state and our nation as just a plain dumping ground. And I live on the water, I have for some time and I see this from time to time, and unfortunately its an educational problem, because a great many people, to a great many people the water is one thing, its a trash can, and this is as I say an educational process, you got to tell some of the old timers, don't put that in the water, and you know they might listen to you, but you walk away and in the water it goes. But all I can say is at the State level and for the association SODA, or any other group or interested individual, if there is some concrete thing that we can do at the State level, and after all I was born and raised right here in Wildwood, and the future of our not only our tourist attraction, but our fishing industry, our clamming industry, every industry, everything that you can think of is all wrapped up in this and I can only say I stand ready to do anything anyone can suggest, or lets say should I come up with something that is even a 2% solution, I certainly would be glad to move forward with it. I'm glad to see the interest here this morning and again I stand ready to work with and serve any group that feels at the state level, at least, there is something that can be done, whether it is temporary, momentary, or long range. Thank you.

ANGELO ERRIKHETTI. If I may, I would like to say I think we have one of the finest men in the country on our environmental State staff, Richard Sullivan, he is a hard nosed guy and he wants the problem solved. I don't believe taxpayers of the State of New Jersey or of this country will tolerate much more of this continued postponement of legislation. It can be done, Mr. Sullivan could

come here tomorrow morning, and this problem is more than stop dumping in the ocean, stop the Delaware River, stop the back bay, stop period, all of the dumping. And Sullivan if he could do it would come here tomorrow morning, but it is a total picture, this is just a part of it, and I say this you have a congressman named Charlie Sandman, and we should have the legislation. This country today is pollution conscious, and the people today are worried about ecology, they know what is going on and they are not going to go for foot dragging. And I think we should say by 1975 no more pollution, clean up the water, whether it be the Delaware River, the back bay, or the ocean. I think its a tremendous problem but it takes action, it takes movement, now we all take oath of office, whether you are Director of Public Works, or whether you are an environmental man.

MAYOR VON SAVAGE. I would like to call on some of the representatives from Delaware. But just to add to this meeting, I have a boy 15 years old, and I think this is food for thought, we discuss things and College demonstrations and what not and that over the years look what has been taking place pollution of waters, and his reply was over the years what has your generation and the generation before you leaving us the younger generation, so these kids today in school are studying sociology, and they have broader programs than we ever had. It is incumbent upon us that we really continue driving, and continue cleaning up our problems, so that these kids coming in, or perhaps will not have a club, and say well you fellows didn't do it your generation didn't do it so we have to do it. I think if we are in a position to do it and with the attitude of the representation here, and a constant pressure I think that we can do it. At this time I would like to call on Delaware delegation, perhaps you would like to add to this or question anything, the Senator perhaps.

THOMAS E. HICKMAN, JR. (State Senator). Thank your Mayor, I mainly came over Ladies and Gentlemen to listen, I think we do have a problem, I think we have all heard about pollution and I can tell you what's happening, and the reason we are here, it has hit us now, this is when we do get the action, and we do have this problem in the ocean, but I think we need to do some planning, I don't think its just that simple that we are going to cut it off tomorrow or 5 years from now, I think we have to plan how we are going to do it. Philadelphia has a problem, I'm sure Camden has a problem, this whatever you want to call it sludge, sewage, has to be gotten rid of. Now there are other ways, I'm sure of this, I'm not an expert in the field, but this is a problem all over the nation. We do hear this word ecology, and this word to a politician is about like motherhood. You know you'll vote for anything that has the word ecology in it, I mean this is going to get you re-elected, but it just is not that simple, and I'm sure that Senator Kay will agree with me that we have responsibility past this, beyond getting re-elected, I mean we have to represent the people and what's best for the people. So I am, the reason we are over here the Delaware delegation, I particularly want to listen, I want to do some planning to see what can be done. From my limited research I don't think that there is any doubt that dumping in the ocean does have some damaging effects. I don't think there is any doubt about this, I think today this is a proven fact, how much I can't answer. Thank you.

MAYOR VON SAVAGE. At this time I would like to call on our Assemblyman, yes sir, the delegation from Delaware would like to continue on, yes go ahead please.

Representative HARRY DERRICKSON. We were not aware of this problem as soon as you were, but I want to remind you that you can stand on your shore down here and see our home, and the same ocean that passes by here, passes by us, and we are very concerned about it. We are involved in it now and we want to learn, and we want to be informed, and have contacts, and we would like to be with you. Thank you.

AUSTIN N. HELLER. Gentlemen I would like to take this opportunity to take this opportunity to thank you on behalf of Governor Peterson, for having invited us today to take part in a meeting where we have a primary concern as you do. The Governor of the State of Delaware gave his state of the state message yesterday, and he made it very clear that he is committed to what he calls a war on pollution. There is no question about our concern to protect the environment of the State of Delaware, and we are as all of you know, very mindful of what neighbors do. We are a part of the Delaware River Basin Commission for example. We are grateful to you especially in the southern part of Delaware, and I might just make a few other points if I may with you. The State of Delaware

reorganized its government just about 10 months ago, and as part of that reorganization placed this entire responsibility for natural resources and environmental control under one umbrella. And I was privileged to be selected to head that department and that activity. I am convinced that this is a milestone in the State of Delaware and a milestone for the nation. When any Governor, any legislature, and I have two legislatures right here with me who took part in this activity recognize that you can't separate out that you can't separate the environmental problems from the problems of our natural resources, so I'm delighted that you invited us to be here with you today. But I would like to make a few constructive comments if I may for you. First of all I don't think there is any question that we know very little about the dumping of sludge or industrial waste into our ocean. We know very little about its ecological effects. So in a sense we are faced with a situation where this practice has been going on for a relatively long period of time. And we have spent very little time or money to make a determination for what that effect is or is likely to be.

For those of us who have been in the environmental fields for many years (Mr. Guarino knows me from past experience) recognize that before we make any judgments we have to get facts, when you can make a determination of what you are dealing with and certainly there have been a number of red flags raised recently. We ought not to set aside, and that is we have pretty good evidence now that somehow the fish life is effected by what happens, in terms of what we humans do on land. The mercury level in tuna fish, and sword fish are classified examples of what this interrelationship is. And in my judgement we can't afford to wait to see this proven. I would like to make this observation and a few recommendations to you. First of all I would like to commend the City of Camden, for taking a position that they have, namely that we have the technology, and it is not necessary for us to dump our sludge digest it or otherwise into the ocean, there is no need for this, and we are really dealing with only one parameter and that is cost. The technology is available to solve that problem, so I want you all to understand that fact. As Mr. Guarino pointed out in 1958 they did make a study of how to do this job, and they did come up with the least cost and the most practical way to solve the problem and that was to dump it into the ocean. But if they were directed to see something, it would not be necessary for them to undertake a major research project. The technology is available for them to solve the problem, if they were told to do it today. So a deadline should be established this is necessary for the City of Philadelphia, to stop dumping into the ocean, I think this is a very important point to be recognized, it doesn't require research to do this, merely a decision not to do it. I would also like to commend the City of Philadelphia for having recognized now an ecology study should be undertaken to see what the effect is, and this is a long term type of study and very difficult to do as Carmen knows, I would suggest that the Governors of, If I may, of New Jersey, and Delaware and perhaps Pennsylvania, convene a meeting with NOAA the agency now responsible with the federal government for managing these problems we have to deal with today. and I would suggest this meeting be convened shortly.

Because the question of ocean dumping in this area is just one part of the total picture. We can't make an assessment really by merely just looking at what Philadelphia does there are many, many places along the eastern seaboard to the best of my knowledge there are about 115 actual ocean dumping sights on the eastern seaboard going on today. So that I don't think that once you make a determination alone, one has to look at this as a problem that we are faced with on a nation wide basis, and especially on the eastern seaboard. And I quite agree that the entire question of what effect dumping in the ocean has on the food chain has not been established, but we have already had the red flag raised, and it does have an effect, and not a very positive effect. So I wish to thank you for an opportunity to make a few observations to make a few comments. The State of Delaware stands prepared to work with this group to come to a practical solution to the problem.

Mayor VON SAVAGE. Thank you sir, and your delegation, for the great concern, and your information. At this time I would say that we are now encroaching on our lunch period, and we have a few more people to call on, and they have points of interest, and without any more talk I'll introduce our Assemblyman James Cafiero.

Assemblyman CAFIERO. Mayor Von Savage this is usually the point of the program where I usually get called upon when I'm encroaching on somebody's

lunch period and everybody is looking at their watch and this is the position I have taken for the last 4 years. For the benefit of those our good neighbors from Camden and Philadelphia and Delaware that are here with us today, I am about to say I'm sure it will be a repeat for our neighbors but I would like to advise you gentleman at least what we are trying to do on the State level, at least in the Assembly.

At the present time there is pending before the Assembly a concurrent resolution #109 that was introduced on December 7th, by 11 or 12 Assemblymen, the prime sponsor who was Jack Lewis from Monmouth and for which I am one of the co-sponsors. The purpose of that resolution was to constitute the Senate and Assembly committees on air, health and water pollution and to study the advisability and feasibility of what laws can be recommended to either control or eliminate the risks and dangers that emanate from the water dumping and also from the dumping of sludge and garbage within the 3 mile limit and without the 3 mile limit. I spoke to Assemblyman Fors last week, and as you know we reconvened on Tuesday for this current session of the legislature and we spoke to the leadership and we have been assured that this resolution will be before the Assembly for a vote on Monday or Thursday of next week. And as the last speaker mentioned I am sure that the Governor is going to be aware of the legislatures interest in it and I agree with you wholeheartedly that we have the technological skill to solve this problem if we are willing to put forth the effort, set the deadlines and prepare to pay the cost. And as you know and I am sure Senator Kay is aware, the biggest factor that faces all of us is cost, and if the people are dedicated enough and honest enough, in their decision and desire to correct this problem, we have the wherewithall to do it, if they are willing to pay the price that it is going to take. As I said for the benefit of these Gentlemen, I wanted them to know where the legislature stands at the moment and hopefully this resolution will be passed, this committee will be brought together, and make recommendations in this particular area, I want to thank you Mayor for the opportunity to be here. And one other message, I don't know for sure who won the Marlin tournament last year, but I know, I was at the dinner, did Governor Peterson win, well I'm sure then he has a personal interest in solving this problem before the next tournament, because he went home with a marlin and a reel and some quite handsome prizes so he has a personal interest to see this problem corrected, because he may be the host next year, and if Governor Cahill doesn't come back with a marlin, Governor Peterson is going to be in trouble. Thank you very much.

Mayor VON SAVAGE. Thank you Assemblyman. I do want to just pass on that was not mentioned, at our meeting that was held over at the Lobster House, that we received word that the City of Baltimore was contemplating getting ready and geared to take their sludge and waste out into the ocean, and of course getting this type of information, we more or less got this group together and it started by Commissioner Ostrander, and Captain Stocker, Mr. Bianchi, Joe Olwell, these fellows deserve a lot of credit and they have been pushing this to no end. And I certainly would be remiss if I didn't recognize these people. And because of their efforts we have this meeting going on and the interest shown. There are a few more important remarks to be passed on and it will be of great interest to you, and its not whats taking place now, its what will follow, Baltimore and now its up in Bucks County, they all have their eyes on this dumping ground, because it is an economic way of getting rid of their waste so with the effort of everyone here, and the adjoining states, and Pennsylvania, we will continue pressurizing different groups on this. At this time I would like to introduce someone who has a good amount of information, and I would like to call on Wilbur Ostrander, Commissioner of Wildwood.

Commissioner CSTRANDER. Gentlemen, thank you ever so much for joining with us today, this is so terribly important, and wonderful that you have chosen to come over and try to get those detailed information on all of the problems we are faced with in our general area, and I must say this that in the last 3 or 4 months a mighty blow has been struck by a group of people, to try to come up with the answers that are absolutely imperative to find at this moment, and I am saying this moment we cannot wait, and we spoke generally about the site off Cape May Point, and I am sure there are those here who may not understand what that site represents. It is 12 miles in circumference and 20 miles of ocean that has been contaminated. And that's the truth, because the shell fishing group in the State of New Jersey has taken it off limits, there are no shell fish allowed

to be taken from that area. Now we have an investment in Cape May County of 40 million dollars in the shell fishing industry, and I think it is outrageous for any City to purpose and dump in this area, and these are the things we are fighting, and we intend to fight, and we intend to criticize or embarrass or whatever we have to in this organization to stop all of this tom foolery. Now the City of Philadelphia I understand treats their sewage 90%, the City of Camden treats theirs 25%, the City of Bridgeton hasn't treated theirs at all, and this is an absolute outrage to expect to move debris into our area in Delaware, New Jersey and Maryland, and infest our waters and jeopardize our economy, and that is just how pure and simple this whole thing is.

And there have been studies made on this area because the shell fishing industry or Institute of North America will not allow any clams to be taken from that area so they are infested, and it is outrageous. And the strange part about all of this, apparently most of the pollution problems we are faced with don't even adjoin the water ways, they have not found an answer to their problem, the waste that they propose to move down here right now is absolutely beyond belief, 3½ million gallons of chemical waste, and that has been in the courts of law for a cost of \$380,000, they could jeopardize 10 million dollars worth of fish life, by putting that chemical in there. And these are the things we are fighting, because we are concerned, not just for the shell fish, nor for the fishing, but the entire economy. If this debris should ever wash up on these beaches in July and August we ought to all hang our heads in shame, and don't say it can't happen, because it happened in Florida, and it happened in California, and this is what this group SODA is doing, and we intend to keep doing it, and we are deeply concerned, and that is why we hope you fellows will get concerned, because you are affecting our economy and we resent it. And we will do everything we can possibly do to stop it. Now I heard it mentioned there are 115 dump sites from Maine to Florida, this is a fact there are 4 in our general area there is one at 200 miles one at 100 miles, one at 46 miles and one right here 5½ miles off our shores, or 7½ miles off the shores of Delaware. Now there are no federal laws existing beyond the 3 mile limit, who allows the Army Engineers to decide where these dumps are to be placed, who are they. This means that you and I and everyone can go to the Army Engineers and say I have some spoils to eliminate and we would like to put it in the ocean, so they immediately give you a permit to do that. But this is outrageous, and please, hopefully through this meeting you gentlemen with the wherewithall from your States and your Congressmen, and United States Senator, go raise the devil. Let's find an answer to this problem, and it must be found before long. Thank you Gentlemen very, very much for attending this meeting, we appreciate it deeply. Thank you.

ANEGELO ERICHELTI. When I first got up to talk I tried to be very polite, he said he resents the City of Camden, Philadelphia and Bridgeton, for going into the ocean and dumping. And I tried to be very polite and say its a total concept. The back water, the bay, now the problem lies in the ocean, fine I agree, we are not the only culprits here though, let's get that straight. You have the back bay here that has been closed for 2 years for your shell fishing, this is your own economy, and you haven't taken action, and you have been fighting whether you should have an Authority or not. And you have been ordered by the State a year or so ago, and you still fighting over it. I don't wish to get in a fuss with anybody, but don't point the finger at the City of Camden. And say you are the culprit, I accept total responsibility, I tried to be very polite, that everyone was responsible us, as well as yourself, and let's work together and try to solve the problem, rather than pointing fingers. I don't like to be fresh, if you want to call it that, I am trying to be very polite, I'll say it again, primary treatment only, you have an authority that you feel you have put together, you have been fighting over it and bickering over it. The City of Camden formed an Authority, you know why, they formed an Authority, because the need was there and it was imperative, and we know this gentlemen, and I am the Democratic City Chairman and I formed it with Republican Mayors, 16 of them, they cast aside petty politics, they cast aside neck biting, they were concerned with one thing, whats best for the tax payer, and we worked together, and we are going to do it, and we are going to solve the problem, not talk about it any more. We are going to give you action.

Mayor Von SAVAGE. At this time I would like to call on Congressman Sandmans representative who has information to pass on to you, that should be of some interest, Mr. Fred Coldren.

FRED COLDBEN. Gentlemen, the Congressman got snowed in or iced in, in Washington today, so he called me, and unaccustomed as I am to discussing things like this, I will try to give you a brief report, that he gave me on the telephone. He commended the organization that is sponsoring this meeting and all of you that are attending, and he asked me to relate three forms of action that he has taken. I have to get out right away, I am going to leave here now, because at 3 o'clock today, he is filing an injunction personally in U.S. District Court in Philadelphia. To stop Bucks County from dumping its sewage and industrial waste in our ocean, 48 miles off. We already have an indication of support from the Attorney General's office in Philadelphia, that this is a friendly law suit and we believe it will be supported, this will be, and I don't know the legal way this works, but he explained to me that this will stop any action until a hearing is held. Until we can determine whether or not this stuff is toxic enough to prohibit it from being dumped at all. And if it is not toxic enough to prohibit it from being dumped at all, the goal is to get it dumped far enough off shore where it will do no damage to the marine life. So that will take place at 3 o'clock today in District Court in Philadelphia. Secondly you all are aware I think of the legislation the Congressman has proposed. In Washington this morning he told me he has the first draft of this on his desk. It's the ocean dumping act, we call it the Ocean Dumping Act of 1971, he has an indication of interest from the administration. Now the Nixon administration in September 1970 issued a national policy report on ocean dumping. In which the administration specified that it would like to phase out all dumping. In the meantime however, it is seeking legislation such as the Congressman has proposed, requiring that dumping take place only in places where it will not harm the Marine life.

We feel this legislation will solve the jurisdiction problem which now exists some 3 miles off our shore, and the details of that have been widely publicized. Point three, he is now preparing letters this morning to State Agencies, the Governors of 2 states, 3 now, I'll recommend that, to the Federal Government there are 4 agencies involved with ocean dumping, and too, the international body that controls, that has certain controls over the high seas. He has done an awful lot of research on this and he feels there is something at each level of government, can do now, under current jurisdiction. And he is prepared to specify that as soon as he has notified the proper officials. So I wanted you to know what he has asked me to relate to you. The injunction today is not for ocean dumping totally, it is strictly for the Bucks County waste. The attorney representing him is in Philadelphia now, the papers have been prepared and the court notified that it is going to happen. Thank you.

MAYOR VON SAVAGE. Anyone who is interested in a transcript of this meeting, kindly leave their name with our Secretary here. Mrs. Hughes, and we will see that you get a copy. Mr. Stocker do you care to say a few words if you would please at this time.

OTTO STOCKER. First of all I would like to get you fellows acquainted, particularly you people from the city, you are on the top level where it has no effect on you, with all the talk that we had, I would like to give you just a little run-back just what has happened. Gentlemen, suppose you were making your living, 5 miles off the coast, along comes a nut who says we are not picking people we are picking the product that is dumped, you have your pots, your lively-hood is there, not only one it is made by hundreds of people along comes a barge and dumps their stuff on top of your pots, what would you do?

The Coast Guard has no jurisdiction they say over this, now then I am going to be brief but get to a point, this is more than just we have been talking, there has been nothing done. First of all Philadelphia says no harm to the ocean, this is dead wrong, your proof of your locations off of New York, it is rotten it is a mess. Off of Wildwood here, 5 miles off it is contaminated, fish are dieing, lobsters can't live there and you can't make a living there. That I would say is a dam big harm, a lot of harm, now then, you gentlemen you have a very crude picture of where the caverns are, there are no caverns where this stuff is dumped, it is as flat as all get out. Now this stuff has been dumped and it has no chance to dissipate at all it is only 55, 60, 70 feet of water, now once this stuff is dropped, you say you people don't know anything about it, we spent a couple of days down there in Delaware, and we were surprised, that you people over there were quite alarmed that it was so close to their shore, every congressman every Senator should know what effect of anythings that is happening around here. First of all, as I said there is no caverns, there is and inspections, this is ridiculous if I go

out there with my boat I got a Coast Guard sitting on my neck, but we are bringing chemicals down from the other places and the Army Engineers and the Coast Guard now I don't want to put any blame on Coast Guard, they are doing one hell of a good job in that ocean, let's give the Army Engineers a chance to do something, there is no inspection of that boat going out into the ocean, dumping, there have been short dumpings, but in this day and age in our country, every body is afraid of their job, the ferry boat captains have told us many a time, when a barge passes and by the time it gets back, it can't possibly go to that ground where they are supposed to be, short dumping this is rotten, but there is no inspection on it, they say how can it be done, but who is kidding, that can be done very easy.

Now, then, the other thing is I've seen ocean currents, I've seen ocean current studies, we've had studies for the last 20 years, and its about time the Navy or the Coast Guard knows something about the ocean. Now another thing Herb Clark was up to put us on a TV program, he said as we were flying over the Delaware, he didn't have any trouble seeing blue water, green water, pink water, you name it and they fined them \$300.00. That is a disgrace, \$300.00 that was easy, that is paid out every day and forget the environment. The other thing is that there is talk about how much the, whether you can get by with something, 75 miles, 100 miles off is the continental shelf, that is the drop off, now you have 55, 60 foot of water, and for you people in Delaware when we get the northeast storms, boy you got a chance of getting it, when we get the southeast storms, Wildwood, Atlantic City, Ocean City, has a chance to get it, I think it's too darn close. Now then the 100 miles that they are talking about, they have barges that are very, very slow, by the time they go down and back, its almost around the clock procedure. There is a company, and I went to a press conference, of Sandman, I crashed it so to speak, I wanted to know what was going on, and I was getting burned up as some of our men are. First of all there is a company in Philadelphia that is making some kind of arrangement, they have 3 ships, and each one holds 10,000 tons, now according to this that is about 3 times as much as the barges hold, and the barges being so slow, going down and coming back, this boat will do 15 miles an hour, and I was talking to the Engineer, and he claims from the 160,000 whatever, the figure was that he could haul it in one trip within the one day limit, by using his equipment, but taking it 100 miles off shore where you have the deep water, where you have the currents, and by the time that sludge does get down to the bottom it has time to dissipate.

Now there is a place you've got to be careful, the washboard area they call it, the off-shore draggers, it is not as simple as taking it that far off. So what I am getting at is this, in the United States, they should be made by the people the laws have an effect on. We're passing laws in your cities and states, and many of you men don't know the first damn thing about this ocean, particularly when I see it says caverns, there are no caverns out there that way, so we get out in that ocean and we drop it, and we make sure that it is not going to hurt any of the off shore draggers, they call it the washboard area. The other thing is at local level, in other words a time limit, from 1971 to 1975 we might as well all go home right now, because you gained not a damn thing. Five more years out there and you won't have a thing, it will be just as bad as New York, and that's pathetic. You take an airplane and go over the top of New York, its a dead sea completely, now this we don't want and it can be stopped. Locally here we want it taken off our shores for those next five years, if it's going to take that long if they are going to dump where they are dumping it now, this is murder. The next thing I hear all kind of people learned people, with all kinds of degrees, and they have come from colleges, they have made one hell of a good decision, they have a dumping area off here that is contaminated one in New York that is contaminated, and if that is good decision they had better go back to college again. Somewhere along the line they lost the reasoning. So to give you how this came about there was a young man came to me and he says, Cap there is something wrong, I can't make a living, they have driven me off the place where I make a living in my small boat. 12 miles off he has been making a living. So thats how this thing got started from the little level, a man can't make his living, he started off with 70 pots, he wound up, his Father and his Uncle, with 1,700 pots, right now he can't make a living to keep him year round like they used to with 1,700 pots, the sludge is getting in his pots, the fish won't go into them, the sea bass pots, so the point I'm getting at Gentlemen, it can be taken off a 100 miles, according to this Engineer, and it was Sandman's recommendation that it can be done almost as cheap as they are doing it now. Thank you.

MAYOR VON SAVAGE. Thank you Capt. Stocker, for those of you who don't know Mr. Stocker spent most of his life on the water out there, he is out there quite often now, and he is associated with SODA, so he is well aware of what is taking place. I see Mr. Guarino has raised his hand, do you wish to make some comment.

CARMEN GUARINO. I don't think we have time for too much discussion but Captain Stocker is evidently a man with a lot of experience and a man we should all respect, because he is out there. And he brought up something which is a little bit different from what we heard before, we heard people say stop it, tomorrow if we can, now we hear something which is an alternate, which may make it easier, or at least an interim measure. And that is take it out further, now you are indicating that it could possibly go out maybe a 100 miles. So here is something, maybe just a step in the right direction, let's find out what we are doing before we have legislation, I tried to make this point before, I'm prepared to make available whatever knowledge I have, and we are hired to do that, and as Engineers for municipalities etc. the money we are spending is yours, if not you its your cousin, brother, sister, there is nothing to gain by an individual trying to dump his problems on someone else. It's an attempt by Engineers and this is a part of their project, every project, they must consider economics, they just can't live in a dream world. So that before you just close the gate, you've got to consider a method which is some compromise can we go out further, but if you just say no then the costs are just going to sky rocket, I would rather be on the otherside of the table right now, I like clean waters as much as anyone. It's a dangerous thing to even get up nowadays and to interject practically, because it's an emotional thing and nobody likes dirt. And today the theory is let's ride on the crest of this environmental wave. And brother that's the place to be. ~~Because you get up and automatically~~ you've got 3,000 people with you. But, why not pause a moment, now I'm glad for you to get up and say that, because no one else I don't think said that here today.

Possibly you could plan it maybe there is some solution, because eventually we are all going to pay the price tag. And can we do everything we want. Can we go to these theoretic extremes, in the case of Philadelphia which people say well that's Philadelphia, let them pay the price tag. And it very well may be the case, but I can tell you the operating costs alone will go up 3 times and you folks are going to come up against the same thing. Wouldn't you want to find a way to do it cheaper so that you and your children would not be faced with a price tag you could have avoided. Maybe one of Captains suggestions maybe that suggestion is a good measure. So I don't want to take up any more time.

Captain STOCKER. First of all ocean dumping was to be put out there as an alternate, so we don't contaminate for five years. This is to protect ourselves, if it is going to take 4 or 5 years, let's not contaminate this area, let's used Federal government, or Federal aid to help offset these cities, who have got this problem. The only thing is if it is going to take 4 or 5 years let's not keep putting it in the same place. Because in 4 or 5 years you are going to have a 40 or 50 million dollar fishing industry out of business. That's what I meant.

MAYOR VON SAVAGE. Thank you, and of course as Captain Stocker said its a temporary measure and I think the City of Philadelphia will probably take advantage of it.

AUSTIN N. HELLER. I would like to address my remarks to what Carmen just said, I don't think its any question that all of us are concerned about the cost to solve our problem, but we have not been concerned, and we should have been about some of the alternatives we have decided upon. We haven't taken the steps to make a determination, when we decided to dump in the ocean where we did, to what the environmental impact is going to be. I would say if you are going to follow through on Captain Stockers suggestion, now you know you are required to develop an environmental impact statement, as to what effect it might be, even if you are going to move out to a 100 miles. You can't make that decision any longer unless you make the determination first. So it would seem to me that this group is entitled to know if you have to take another step, and you are not permitted to dump on the outside, or if you are going to say we can't dump 100 miles out, we would like to know what the comparative costs are going to be. I don't think that they are that far out of line. From my own past experience, if you had to make a decision not to dump, and experience is first rate with handling of digested sludge, as you know. It doesn't have to be done, that's my point. Thank you.

Mayor VON SAVAGE. I would like to at this time call on Mr. Tony Bianchi, for a word and then you Joseph.

TONY BIANCHI. I am not apologizing for SODA association but I do want to tell you that we are not here to harrass you or offend you, we want your friendship, we are all concerned with pollution. You must remember that here in south Jersey our livelihood is contingent upon two things, that is the tourist, and the fishing industry, people are, and they have and they will, continue to pass through your city, and through your state, and in doing so are spending money and this is a source of income for you. This is why we are concerned, we don't want our economy here effected in South Jersey. Too long have we raped nature, we cannot go on poluting the air, dirtting the earth and contaminating the water. So rather than words, let's all become part of an action team. And do something instead of saying something. Thank you.

JOSEPH OLWELL. Thank you, I appreciate the gentleman from Camden for being polite, and I hope that I would reciprocate in the same manner, and put this in a polite way. This association had its first meeting SODA, now I think we have come an awful long way since December 8th, since then the Federal Funds have been withdrawn from Baltimore, to carry their waste out there. Now, I liked the word Mr. Coldren used, friendly, this is a friendly injunction, well I look to SODA as being a friendly organization, because the way I see it we want to being pressure not to the detriment of Camden, Philadelphia, or any other city, but to bring pressure to help the situation. The city of Camden is not responsible for all the pollution problems, it is much greater than this. I think anybody that walks the streets is responsible for a little pollution. I saw somebody throw a cigarette in the street. So it's a broad problem. I've attended several meetings of the Isaac Walton League here in Cape May County, and the second meeting I was there I got a little sick at all the problems that are involved. Now I think here is the thrust, if we can help solve, if we can solve the problems of big cities like Philadelphia and Camden, if we can help you solve your problem, I think we can solve a lot of problems across the entire country, because I think what it calls for is a Federal program. And it calls for money, and I think if we have the money we can do it. Now, enter SODA let's put the pressure to get the money, let's get the job done. How many times do we have to go to the moon? Fine, that's a wonderful venture, but let's take care of this terrible thing that is happening right here today, in all forms of dumping, not just sewage, but the chemicals and acids, and even the Federal Government is responsible for this dumping. So I want to thank you for listening to my remarks, and I hope that we can meet together amiably and sit down and work out a much quicker solution to this thing. And, incidently, I think we have come a long way in the last 6 weeks. We sat over at the Lobster House and the experts told us don't look to an end of stop ocean dumping for another 10 to 15 years. Now we seem to be talking about 4 or 5. We just picked up 10 years. I think we are doing terrific. Thank you.

Mayor VON SAVAGE. For a brief remark I would like to call on the Mayor of West Wildwood, at this time Mayor Robert Hentges.

Mayor HENTGES. Thank you Mayor the gentlemen from Camden is a man after my own heart, what we do need now is action now, and some type of device to stop the dumping in the ocean completely. I saw a movie a week ago, and I certainly would like to suggest that any of you who do go to the theatre, it was called "One Blade of Grass", it was about pollution, ecology and it was filmed in England. And it was theoretically based on the fact that all sea life had died and there was no fish available for consumption any more, the grass was dying and the air was polluted and England was bombing their cities with nerve gases to kill the population, so they would have enough food for a certain given number of people. And as I left the theatre, I heard one woman remark to the lady she was with, how absurd this was, how far fetched it was, but then they said that about Buck Rogers many years ago, about flying to the moon and we have done that. I think if Richard Sullivan has the answer to this problem, then Mr. Sullivan ought to be the man to come forth and say what the answer is, I don't think we can afford to talk too long or wait too long, because we may not have that time to do so. I think the time is right now for action, we have problems, as the gentlemen from Camden said, not only in the Atlantic Ocean, but in the Delaware River, and the Delaware Bay, and in our own back bay waters. It is not always a popular decision, politicians don't always get elected all the time for making unpopular decisions. But it takes a lot of courage, it takes your own convictions, not necessarily what is politically expedient, but what is right, if somewhere along this line, in the not too distant future, something has to be done, and done right away. Thank you.

Mayor VON SAVAGE. Thank you Mayor, some of the boys are raising their hands, to speak, we only have a little time, but I think we heard from everyone, I'll ask one more time if anyone would like to make some remarks. Feel free to raise your hand and come forward, we don't want to neglect anyone. We want to thank everyone for being here. I see the good doctor here is raising his hand, do you want to speak Doctor? Dr. Hornstine the City of Wildwood.

Dr. S. HORNSTINE. I didn't plan on speaking here, but I do want to commend and congratulate the organization that has started, everyone here has talked about the economy, as far as fishing contamination of the ocean, as far as the fishing industry and the clam industry. I am also interested in that, but I think my most interest is in the health and welfare in the tourist and the people here in Wildwood. Listening to someone stating about reports is like a textbook case history of a disease you hear all the normal things that happen, but you never hear about the abnormal things that happen in which many patients die. I have heard of the surveys taken out here in the ocean, the bicolli count that was taken, but I wonder if any of these counts were taken during a northeaster or the day after a northeaster. Or when all the debris is washing up on our shores, from the contaminated water, I wonder what the bicolli count would be then. Two years ago of which our Commissioners know, we had thousands of dead fish floating to our shore, from Cape May, Wildwood Crest, Wildwood, North Wildwood, and Stone Harbor. The State department of health they sent down the State fish and wild game commission. To this day we have never gotten a report as to what caused these fish. I wonder now after all this publicity, that this organization has given if that should happen this summer, I think you will know what the public will think is happening, that our water is contaminated, and that's all we need down here at the seashore. Let's have one case of typhoid, whether it came from the ocean or not. But with the question that it could have come from the ocean, just imagine what it could do to our economy here as far as tourist, as far as the city, as far as our economy, well I am interested in that but as I say, I am interested, fine, but do we have to wait until we have a couple of dead people around here before we can get action from either the state or government to stop this contamination.

Mayor VON SAVAGE. Thank you Dr. Hornstine. Otto Stocker told me not too long ago when we were out in the ocean there on the captain's boat, and he read somewhere in a book when the birds and the fish start running away, and can't live in their environment, then you and I had better sit up and take notice. And this is true. So I think that there has been a lot of good information passed, I think there is a great deal of interest, and with the constant interest I think we will accomplish something that is real important to us. Now before I close on behalf of the Mayor of Wildwood and the association here we invite all of you here at this meeting, to go to the Happy Hour for luncheon. So when this meeting comes to a close, it's not too far, Pine and Pacific Avenues, and we want all of you people to join us in a little lunch. Yes Sir.

Captain STOCKER. May I say one thing, this SODA organization that we are in, we don't think each town should take it on his own, the Federal Government should, they finance things all over the world, no matter where you go, the thing is through this organization, put pressure on the Federal Government, say look this is our problem, and we have no, we are not sore at anyone, we just hope that we can get together, keep people working, this is what we mean, so don't get me wrong we are not criticizing anyone, it's no one's fault, we just hope we can all get together and say look, let's get the Federal Government to give us a hand.

Mr. LAPIDUS (news reporter). May I ask does our luncheon menu include lobster and fish?

Mayor VON SAVAGE. I won't comment on that. We thank you for coming and hope to see you over there.

**STATEMENT BY MRS. M. A. VREELAND, PRESIDENT, MONMOUTH COUNTY COUNCIL
OF THE LEAGUE OF WOMEN VOTERS**

The Monmouth County Council of the League of Women Voters appreciates this opportunity to file a statement, which we hope can be incorporated into the record of these hearings, concerning pending legislation to control water pollution.

The League at all levels has long actively supported the setting of high Water Quality Standards. We, in Monmouth County, in the process of our study of the county's water resources, have also given a great deal of research and thought to

the specific subject of ocean dumping. We shall confine our statement at this time to the practice of sewage sludge dumping as it has affected the quality of the waters and the life they sustain off the Monmouth County shores.

From the material we have read and the interviews we have held, it is evident to us that serious damage to the ecology of the New York Bight has occurred as a result of the dumping of sewage sludge in the ocean. Of immediate significance is the discovery that approximately fifteen square miles of formerly productive ocean bottom lies buried under a four-foot blanket of deposited sludge. The fact that this sludge has not dispersed and been absorbed by the ocean has been an obvious shock to scientists and officials concerned with recent studies of the dumpsite area. Observation of the effects of the smothering blanket produced further discomfort. In the center of the deposit no life was found. Around the periphery, the forms of life were very low and adapted to living in polluted waters. In its natural state, this area had supported economically valuable yields of lobster, crab and surf clams.

Aside from the literal smothering of the ocean bottom on which plant and animal life would have been expected to thrive, a cause of the lack of sea life in the area of the dump is a sharp depletion of the oxygen in the water. This situation may be expected to continue long after dumping is stopped due to the accumulation of organic matter and other oxygen-demanding substances in the sludge. This lack of oxygen produces undesirable effect on fish and shellfish ranging from sterility to death and encourages a profusion of algal bloom that may ultimately also cause the death of the waters in the area.

Effects of the dump on man are equally threatening. The Food and Drug Administration in tests of shellfish taken from the New York Bight as far as six miles from the sludge dump has found a coliform count 50 to 80 times higher than their standards. In May, 1970, a large area was closed to shellfishing. Other tests by the Marine Laboratories at Sandy Hook and others have indicated widespread infection among finfish, and shellfish have been found to be directly infected with organisms producing such diseases as hepatitis and polio in humans.

Further, sewage sludge has been found to contain significant amounts of metals such as lead and copper. Zooplankton, on which larger fish feed, have been found to show traces of these metals. As higher forms of life become involved, magnification of the amount of toxic metals occurs. What effect this concentration in our seafood may have on humans can only be surmised, but it is known that such concentrations can have deadly effects on other organisms.

In addition to these obvious threats to the health of the ocean and the fish and, indeed, the human life dependent upon them, we must consider the potential threat to the economy of Monmouth County. We are an area dependent for a large share of our income on resort business. Easily identifiable "artifacts" from the sludge dump have washed onto our beaches and a floating scum has many times been observed to be carried by the current far from the dumpsite itself. The Federal Water Quality Administration—now the Environmental Protection Agency—has stated that sludge floatables may travel far on the surface, may cause odors and may carry pathogens to recreational areas. It appears that the waters of Monmouth County meet these qualifications.

The Environmental Protection Agency has also stated that sludge deposited in the ocean should produce, among other things, no accumulation of bottom deposits and no concentration of toxic material detrimental to plant or animal life. It is more than evident that the operation off the coast of Monmouth County does not meet these criteria.

The county's use of the dumping area is primarily for disposal of sewage sludge. Members of the League in Monmouth County, therefore, are concerned that our regional sewer systems, now in the process of planning or construction, will, in some major instances, continue to barge their sludge to sea. We believe that this practice is economically short-sighted and potentially dangerous to the health and welfare of citizens and the ocean ecology. We are well aware of the tremendous dollar cost as well as the cost to the inland environment of these regional systems. It is our belief, however, that the relatively slight increased cost of producing some form of dried sludge that can be disposed of on land does not warrant continued pollution of our ocean waters. Further, disposal of dried sludge on land should provide no problems for years to come in Monmouth County.

In summation, members of the League in Monmouth County welcome the interest shown by the Administration and the Congress in seeking a solution to the

ocean dumping problem. We will be deeply gratified by legislation that will require the prospective regional systems in our county to treat their sludge for ultimate disposal and reuse on land. We will also appreciate the phasing out over a period of time of ocean dumping by plants already constructed and designed to employ this practice.

STATEMENT BY HOWARD H. SEYMOUR

Ever since I have been old enough to reason I have always been told and believed that this country and what it stands for are the greatest things in the world. I was most honored and happy to help my country during World War II, when I served in the South Pacific in the United States Navy. I still believe this is the greatest country in the world, but after the bureaucratic fracas that took place in Rehoboth Beach, Delaware, on March 26, 1971, I begin to wonder if I am thinking straight. I was under the false impression that some of our highest, most honored, elected officials were concerned enough to come into our area to listen to testimony offered by our fishermen, clambers, etc., that are vitally concerned about a very real problem. What a letdown I received! I never will be able to understand why the taxpayers paid to send some of the Senate Subcommittee on Pollution to Rehoboth Beach from Washington, to listen to testimony (?) from a man stationed in Washington who also was sent to Rehoboth. Couldn't this just as well have been done in Washington?

I have never been able to fully understand the rules and regulations of protocol and I am sure there is a need for a certain amount of it, but the flagrant abuse of common sense over protocol that took place last Friday was disgusting to say the least. There was not a witness who spoke from the time the Hearing (?) started until after 4 PM when only Senator Boggs was present, who could not have gone to Washington as easily as he came to Rehoboth Beach, without the loss of a days pay because most of them have either State or Federal positions and this is a part of their job. On the other hand the fishermen, clambers, etc., had to lose a days wages by staying off of the water, spend their own money to attend and testify (that's a joke) at the same time paying the salaries of the State and Federal Officials who appeared as witnesses. Then these watermen were afforded the glorious gesture of having less than 1 hour (most of the men had to make the 5PM ferry back to Cape May) to express their views and knowledge. What a complete joke! I can think of no time in my life when I have been more disgusted at politics and the bureaucratic processes than at the conclusion of the so-called Senate Subcommittee on Pollution on Friday March 26, 1971.

There was testimony given by a Dr. Robert A. Erb, representing the City of Brotherly Love, that we in direct conflict with that of James L. Verber of the FDA, whose department has actually closed 120 square miles to the harvesting of shellfish. The boat captain that took the FDA scientists out for samples, is now taking out the Franklin Institute group for sampling. I certainly feel he could shed some light on who is taking biased samples, however no one thought to seek his experiences. Experience is all he has, not a PhD. I would therefore assume that whatever he has to say is not that valid.

I graduated from the Pennsylvania State University in 1952 and for the 4 years I was on campus I took notice that every spring the entire campus lawns, etc. were given a generous helping of a product called "Milorganite", the dried product of the Milwaukee, Wisconsin Sewage Disposal Plant. I am under the impression that they still purchase and use this product. My question is why the Pennsylvania State University supported largely by state funds spend Pennsylvania taxpayers money to buy a product from another state? What is the matter with the City of Philadelphia selling their remarkable product to the Pennsylvania State University? I'm sure the peoples of this area would make the sacrifice of receiving Philadelphia's "beneficial results" in order to help the State of Pennsylvania solve some of its financial problems.

Question: When Philadelphia first started to barge this remarkable product to our shores it had been suggested that this product be hauled to the Scranton-Wilkes-Barre area and dumped in the deep mines and also the strip mines in order to rebuild these areas. The people of those areas raised such hell about this that Philadelphia now gives it to us. How could the people of the Scranton-Wilkes-Barre area be so ungrateful as to not accept this "remarkable gift from Philadelphia," or do they know more of its contents than we have been told?

Question: Does it not seem stupid to haul water from Philadelphia to offshore to dump it? If 5% of the product is soil and sand and 5% is a humus like substance then the other 90% is water. With 118 million gallons total and 90% of this water this means that Philadelphia is barging down to us 106,200,000 gallons of water. We really have all the water we need down here. Sometimes we even have too much! Progressive farmers long ago felt it was stupid and expensive to fill their silos with grass and corn that was loaded with water. Today many of these farmers mow the grass and corn and let it partially dry before they ensile it. Isn't there someone in Philadelphia with enough degrees to figure out that hauling water by barge is an expensive proposition?

Question: Being instrumental in the formation and activities of the Delmarva Artificial Reef Association it has always bothered me that it took us 11½ months to obtain permission (not a permit) to dump something constructive on the ocean floor—in an area where the Corps of Engineers says they have no jurisdiction—when chemical companies, etc. can obtain permission in weeks to dump some of the most toxic compounds known to man. I refer to Arsenic, Chromic Acid and Copper Sulfate!

I have never before written a letter such as this, nor do I enjoy writing a letter that is sarcastic and hateful; however after seeing the way some of our local watermen were treated by our elected officials I can find no other recourse.

My last statement is centered strictly for Senator Muskie in the form of a constructive idea. If sir, you plan to run for President in 1972 I feel it would be a waste of your time and money to campaign in either Sussex County, Delaware or Cape May County, New Jersey for I feel very strongly your chances of carrying either of these two counties would be slim at best.

STATEMENT BY RONAL W. SMITH, BIOLOGIST

I attended your subcommittee's hearing on ocean dumping in Rehoboth on 26 March 1971. At that time you said additional comments could be forwarded to you on the matter of ocean dumping. My personal comments are listed below, and do not necessarily reflect the feelings of the University.

1. The burden of proving that there are no harmful effects from the dumping of wastes in the ocean, or anywhere for that matter, must rest with the originator of the wastes and not with a protection agency. It seems like it has been the other way around in the past, and this has been one of the factors in our accelerating environmental problems.

2. Properly treated sewage sludge from human wastes only might possibly be used on land and in water as a fertilizer. However, when industrial and other commercial wastes are mixed with human wastes and all treated simultaneously, the sludge becomes unusable for natural use because of contamination by heavy metals and other toxic materials from the industrial and commercial wastes.

3. Critical attention must be given to the quality and duration of any scientific study before comparisons are made between different studies. For example Franklin Institute's study of 2 months duration in the sludge dumping site off Rehoboth cannot be compared to a study done in this area over a longer period or at a different time of year.

STATEMENT BY JEROME SPINGARN, CHAIRMAN, SPECIAL PROJECTS COMMITTEE, OCEAN VILLAGE COMMUNITY ASSOCIATION

IF THE CLAMS ARE DEAD, HOW LONG CAN THE BATHERS SURVIVE?

The Ocean Village Community Association, representing eighty families who have constructed summer homes on a beach front one mile north of Bethany Beach, Delaware, wishes to associate itself with the opposition being expressed at your hearings by other residents of the Delaware and New Jersey coasts to the pollution of Atlantic Ocean waters.

Our community is five years old. There has been a perceptible increase of pollution in the water every year since we first built our homes along this beautiful stretch of sand.

The pollution is of several kinds.

1. *Garbage and sewage.* In general, the ocean water is clear, but on some days there is a concentration of particles, like sprinkles of coffee grounds in a basin full

of dishwater, which obviously result from inflows of ground-up garbage or sewage. We are unable to explain why we get this pollution on some days and not on other days.

2. *Garbage and trash from boats.* Uninhabited portions of the coast are strewn with milk cartons, beer cans, egg crates, plastic bottles and aerosol cans. These are probably discarded both by pleasure craft and large ships which ply the coastal waters.

3. *Oil and tar.* A good deal of oil and tar is washed up on the sand. This is visible as a line of black sand near the highwater mark. When it is covered by wind-blown sand, one cannot avoid stepping into it. Every cottage along the beach has solvent and rags for foot-cleaning.

We should like to offer some suggestions with respect to each of these three types of pollution.

1. *Garbage and sewage.* It is hoped that Congress will take speedy action to compel nearby cities to cease dumping garbage in the Delaware Bay and the Atlantic Ocean. We recognize the difficulties which the cities face. But we understand that technology provides new approaches to these problems. Philadelphia, like other cities, has many problems, and if it can solve its waste disposal problem by merely tossing garbage out of sight, it will do so. Congress can end this dispersal of filth only by writing very specific prohibitions, providing condign penalties for violations, and giving technical assistance and financial aid to enable cities to adopt more salutary practices. But *unless* Congress acts, the Atlantic Coast will be doomed as a resort area in a few years. If the clams have died, how long can bathers survive?

Because of the complexities of the problems, we tend to temporize, procrastinate and excuse. It is hard for a city to solve its problems so we wait for new developments. But when we take the pressure off, the city government relaxes, another decade passes, garbage multiplies in quantity, and intensifies in toxicity and perdurability. Cities should be compelled to face up to this problem now. Strikes of garbage collectors all over the world have resulted in garbage accumulations on streets but they have also forced city authorities to face up to personnel problems. The time has come when they should address themselves to their disposal problems, or accept the consequences.

2. *Garbage and trash from boats.* The increase in pleasure boating has resulted in a great increase in waste material from boats. The practiced seaman, who understood rules of shipboard conduct, including the handling of waste, is no longer your typical boatsman. And a large part of the waste from pleasure craft consists of modern packaging material which does not disintegrate. The Coast Guard should be asked to look into this matter, to enforce all existing legislation against aquatic littering, to educate mariners and to propose additional legislation. Dumping by freighters and liners should be studied, and it should be determined whether this presents a problem.

3. *Oil and tar.* It is generally believed that the oily black substance that covers parts of our beaches results from the cleaning of tanks and the dumping of oil wastes by tankers entering and leaving Delaware Bay. This problem requires serious study by the Coast Guard. The Coast Guard is prepared for the tanker wreck, but it is not now equipped to catch the tanker crew that flushes its tanks too close to shore. And here, too, existing legislation is insufficient. We need a thorough investigation of routine practices by ocean going vessels which threaten the coastal bathing facilities. We need stricter laws regarding the operation of tankers and an improvement of the police methods by which the laws can be enforced. It is admittedly difficult to apprehend seamen who flush tanks under the cover of darkness. But have we considered rewards for informers or qui tam class actions by aggrieved individuals, associations, or municipalities? Some authorities have told us that our power to deal with this problem stops close to our shores. But we have been advised by experts in international law that a nation's power to deal with threats to health extends considerably further than the usual jurisdictional lines. These are serious issues, they are new issues, and they require careful attention by men and women who have background in a wide variety of disciplines.

* * * * *

For the record, we should make it clear that this statement is addressed to a few selected threats to our seashore because these threats are the subject

of this Hearing. The Ocean Village Community Association is also concerned with a variety of other threats to our coastal environment which are not germane to this Hearing. They range from pedestrian litter, use of motor vehicles on beaches, unplanned development and construction, and threats to our valuable wetlands. Our failure to discuss them at this time does not mean that we do not regard them as related and important aspects of the effort to protect our environment.

The middle-Atlantic coastline includes the finest bathing beaches in the world. The smooth sand, the wide strand, and the moderately vigorous surf, are ideal. Other beaches may have longer seasons, more scenic back-grounds. But no beach in the world offers bathers the strand and surf of the Middle Atlantic coast. It is seriously threatened, however, and its pleasures will be lost to the next generation unless our generation acts wisely. Our power to pollute and destroy increases every year. Byron wrote that "Man marks the Earth with ruin/But his control stops with the shore." Lord Byron, alas failed to anticipate the achievements that the next century and a half would bring.

STATEMENT OF JOHN R. STENGER, LEWES, DEL.

The stream which runs through my boyhood home in Lost Creek, Harrison County, West Virginia, (Lost Creek) once ran clear and clean. Lost Creek was filled with various crustacea (crawdads, etc.) minnows (chubs, bass, catfish and perch). On its banks I once could see tracks of mink and muskrat. My father has pointed out to me that no longer does the mink hunt the banks of the stream. The crabs are gone. Fish no longer swim in the stream. The stream is today running red from sulfur compounds emitting from the deep and surface mines that rape the scenic beauty of what West Virginians used to call their "Switzerland of America."

My dad is not an ecologist; yet he is quick to see the relationship of the lower forms of life in that stream to the mammals, mink and muskrat. The mink is gone NOT from overtrapping by man but from overstepping into the realm of pollution. When mink and muskrats go how long is it until man himself will follow?

Off Cape Henlopen is what is called the "Dead Sea" created by ocean dumping of sludge. At Cape Henlopen we can no longer take clams because the waters of the Delaware Bay pollute the sand flats, along with sewage from State, City and County wastes.

Our mountain streams are becoming sewers, our rivers and bays are cesspools and conveyers of trash and our oceans will not long take all this without joining the same grave. The ability to receive this is not limitless and ocean dumping should not be permitted. The burden of proof must lie with the dumpers.

Go out to the "Dead Sea" where today there are no crustaceans and clams that are unpolluted. Go to the dead streams at *your* boyhood homes. Ignorance might be understandable. But we know better and must not continue the degradation of the oceans and their tributaries. I am certain that you have ample testimony from ecologists; but if not, just go and see for yourself.

I submit that if "God is Nature" (as some may put it), then to rape our hills and streams and bays and ocean shores is to RAPE GOD!

You have within your means (the committee) to recommend steps to revert the rape of the past and present. Pass legislation that will hurriedly clean up this mess. The public must be made to *pay the price* and you must sense that people expect you to get strong legislation passed, and demand that it be enforced.

May I close with a bit of prose

If we don't immediately	S.O.D.	(Stop ocean dumping)
currents could	S.O.B.	(Surface on beaches)
leaving their	S.O.D.	(Sediments on dunes)
so, hear our	S.O.B.	(Scientists of biology)
better	S.O.D.	(Stop ocean dumping)
and	S.O.D.	(Save our dunes)
lest we be	S.O.B.'s	(Sewered ocean bathers)
signed by	S.O.B.	(Scientist of biology)
	B.S.	(Bob Stenger)

STATEMENT OF MALCOLM H. TAYLOR, PH. D., LEWES, DEL.

I was in attendance at the recent Ocean Dumping Hearing of your subcommittee in Rehoboth Beach, Delaware. Although I am a research biologist with the University of Delaware Marine Laboratory, I speak as a private citizen, not as a representative of the University.

A significant generalization to be made from the scientific testimony is that at present our knowledge is not adequate to make intelligent decisions regarding what can safely be dumped in the ocean. However, we do have the historical evidence from the Great Lakes and numerous estuaries indicating that finite limits exist. In light of these facts, the placing of the burden of proof on the party seeking to dump must be a basis for ocean dumping legislation. Ignorance of potential results has been used as a license for dumping in the past. It should now be obvious, with the task of reversing the effects of this practice before us, that its continuance is unthinkable.

With regard to the conflicting testimony given by Dr. Erb of the Franklin Institute and Mr. Verber of the Food and Drug Administration, I think a significant observation was made by Capt. Stocker, of New Jersey, who piloted the boat for both groups. He said that Dr. Erb's sample which contained no evidence of pollution came from a high area in the dump site, while the FDA samples, which were heavily polluted, came from deeper zones. Common sense suggests that settling of the dumped material would lead to accumulation in low areas.

I personally have no reason to doubt Dr. Erb's data, but his total lack of scientific objectivity would suggest caution in the acceptance of his interpretations of those data. Examination of the animals themselves is the key to the question of pollution at the dump site.

Finally, I wish to make note of the unfortunate, although possibly unavoidable, scheduling of witnesses which resulted in some of the local witnesses being forced to leave before they were heard, and the others speaking to a committee represented by Senator Boggs alone.

Thank you for your attention.

STATEMENT BY EDMUND THELEN, CONSERVATION CHAIRMAN, ATLANTIC CHAPTER, SIERRA CLUB

This statement is presented on behalf of the Atlantic Chapter, Sierra Club.

The disposal of sewage sludges and other waste products, whether to air, water, land, or ocean, presents difficult environmental problems. The best solution for one city may well be different than for another. No method of disposal may be selected with intelligence until all of its environmental factors can be evaluated.

The environmental hazards of ocean dumping of sewage or sludge have been illustrated in the New York bight and in the banned shellfish off the Delaware coast. Dumping in the New York bight was practiced for many years with no reports of distress until the quantities were increased beyond any assimilative capacity of the ocean.

It is evident that both the type and the amount dumped must be controlled if environmental damage is to be avoided. It is not evident that ocean dumping per se is more harmful than the alternative methods of disposal. In fact there is the possibility that a properly treated sludge, spread into the ocean in tolerable amounts, may even have nutritional value for the ocean flora and fauna.

In the light of the above considerations, a flat ban on ocean dumping of any product from sewerage would appear to be unreasonable and unwarranted at this time. Much more to the point would be an effective system of licenses and inspections to assure that any material to be dumped has been treated suitably for this purpose, and that in the selected area of dumping, the amount in any given time should not exceed tolerable limits. It is believed that the Environmental Protection Agency might well be given sole jurisdiction and adequate authority and resources to control the quality and manner of dumping under an enforced license system. The EPA already has cognizance over air, water, and land disposal, hence should be in better position than any other group to estimate the relative merits of ocean dumping vis-a-vis these other forms of disposal.

It is also recommended that research efforts be increased to determine the environmental effects of present dumping, the treatments required to make sludge acceptable or beneficial for ocean disposal, and the places and concentrations of dumping least likely to be deleterious.

STATEMENT BY MR. JOHN TROXELL, THE TRI-COUNTY CONSERVANCY OF THE
BRANDYWINE, INC., CHADDS FORD, PENNSYLVANIA

SUBJECT: Comments on Ocean Dumping (U.S. Senate Subcommittee, Rehoboth Beach, Delaware, March 26, 1971).

Reference is made to the testimony given by Samuel Baxter and Robert Erb at the Ocean Dumping Hearings held by the U.S. Senate Subcommittee, March 26, 1971, Rehoboth Beach, Delaware, in which they emphasized that digested sludge, particularly from the Philadelphia, Pennsylvania, treatment plants, can be beneficial to the aquatic life of the ocean. Studies concerning this concept have been conducted by Doctor Erb since January, 1971, and they are evidently planned for a full year. It is suggested that, in light of these plans, conclusive statements concerning the effects of ocean dumping be delayed until completion of the study. The studies could be improved greatly by systematic chemical and biological sampling outside the dumping area where waste material is dispersing.

1. Specific comments are made on papers themselves near appropriate statements or paragraphs. Read both papers.

2. General Comments:

The overall scientific procedure and expression is poor, when you consider that many conclusions are based on limited sampling in time and space. Testing has been conducted only since January, 1971, and it has been done only in the dumping area. They have made no effort to sample outside the area in question nor have they sampled or conducted studies where the drifters have been picked up.

You will notice direct contradictory statements on volumes of sludge dumped per year and time of digestion.

How do these people differentiate between their digested wastes and other wastes being dumped in some area?—Buckley

By their own admission and project design, these studies are to be carried out for a year in an effort "to find out what is really happening."

Erb is a chemist—what are his qualifications for conducting biological studies?

Both parties maintain that this digested sludge is beneficial to aquatic life. Have any studies been conducted to prove or negate this statement? Research should have been conducted prior to any influence on the ocean to find out what kinds of biological populations existed and their competitive stability.

Only by doing this could you say that flora and fauna have been helped or benefited by influences.

What work is being done to show any increased productivity now? If their basic premise is that these will be improved productivity, then scientific doctrine dictates that this should be shown as correct or false. These people are trying to prove what effects are not present, and not what the benefits are for sea life.

(Specific comments have been retained in subcommittee files.)

The following material was submitted for inclusion in the record by Senator Buckley:

UNITED STATES SENATE,
COMMITTEE ON PUBLIC WORKS,
Washington, D.C., April 8, 1971.

Mr. LEON BILLINGS,
Professional Staff, Subcommittee on Air and Water Pollution, New Senate Office
Building, Washington, D.C.

DEAR LEON: I would appreciate your adding the enclosed statement to the record of hearings currently being conducted by the Subcommittee on Air and Water Pollution on S. 523 and S. 1238, the "Marine Protection Bill". I believe it would most appropriately accompany the recent hearings on Ocean Dumping. The maritime insurance industry makes an important point and I think it should be part of the record.

Thank you.

Sincerely,

JAMES L. BUCKLEY.

Enclosure.

STATEMENT SUBMITTED ON BEHALF OF THE LONDON GROUP OF PROTECTION AND
INDEMNITY ASSOCIATIONS, THEIR RESPECTIVE MEMBERS, AND THEIR REINSURERS
BEFORE THE SUBCOMMITTEE ON AIR AND WATER POLLUTION, SENATE COMMITTEE
ON PUBLIC WORKS

This statement is submitted on behalf of Assuranceforeningen Gard, Assuranceforeningen Skuld, The Britannia Steam Ship Insurance Association, Limited, the Japan Ship Owners Mutual Protecting and Indemnity Association, The Liverpool and London Steam Ship Protection and Indemnity Association, Limited, The London Steam-Ship Owners' Mutual Insurance Association Limited, Newcastle Protection and Indemnity Association, The North of England Protecting & Indemnity Association Limited, The Standard Steamship Owners' Protection and Indemnity Association Limited, The Standard Steamship Owners' Protection & Indemnity Association (Bermuda) Limited, The Steamship Mutual Underwriting Association Limited, Sunderland Steamship Protecting & Indemnity Association, Sveriges Angfartygs Assuransforening, the United Kingdom Mutual Steam Ship Assurance Association (Bermuda) Limited, The West of England Ship Owners Mutual Protection and Indemnity Association (Luxembourg), ("the Associations"), their respective members and their Reinsurers.

THE NATURE AND FUNCTIONS OF THE ASSOCIATIONS

The 15 Associations named are sometimes collectively referred to as the "London Group". Four are actually based in London and four in other English cities. Two are Norwegian, one is Japanese, two are Bermudian, one is Swedish and one is Luxembourgian.

The Associations are composed of the owners and operators of approximately three-fourths of the world's ocean-going vessel tonnage, flying the flags of almost every maritime country, including approximately four million tons under American flag. The members of each of the Associations mutually agree to indemnify each other, through the medium of their particular Association, against legal liabilities of numerous types arising out of the ownership and operation of their vessels, including liabilities for pollution damage caused by the discharge of oil and other substances.

In routine cases the liability is covered entirely by the particular Association with which the vessel concerned is entered. In more serious cases, however, pooling agreements among most of the Associations provide for a sharing of liabilities in excess of the amount of the "retention" of the Association with which the vessel is entered. However, in respect of claims in the catastrophic category, the Associations, as a Group, carry reinsurance with Lloyd's Underwriters and with American, British, Continental European, Australian, Japanese and other insurance companies.

The Associations have been approved as insurers by the Federal Maritime Commission ("FMC"), and their certificates of insurance, issued on behalf of their respective members, are accepted by FMC as evidence of financial responsibility under the Federal Water Quality Improvement Act of 1970 (P.L. 91-224, Title 33 U.S.C. §§ 1160-1175) ("W.Q.I.A.").

THE INSURANCE COVERAGE AFFORDED BY THE ASSOCIATIONS

In the case of most ocean-going vessels, prior to the enactment of W.Q.I.A., there was no policy limit on the amount of insurance provided by the Associations in respect of any liability insured against, including liability for oil pollution. In other words, these policies had no monetary ceilings and in this important respect the insurance provided by the Associations differed very materially from practically all other commercial insurance. This was possible because the Associations were able to obtain reinsurance on the world market in very substantial amounts. Such reinsurance was in turn made possible because the reinsuring underwriters could rely on the fact that under maritime law civil liability for property damage was based on fault, and the amount of such liability could be limited to reasonable figures, where the fault was that of the vessel's master or crew, and not that of the owner himself.

However, largely as a result of W.Q.I.A., which (1) created an additional "limitation fund" of \$100 per ton for United States Government oil pollution claims alone, (2) imposed "strict" liability instead of the traditional concept of fault liability, and (3) provided for direct actions against insurers, and the concern that other governments might follow the example of the United States and adopt similar legislation, it has proved impossible for the Associations to obtain reinsurance for oil pollution liabilities in anything like the amounts available in respect of other types of liabilities. When one liability is singled out by special legislation for exceptionally severe treatment, as is now the case with oil pollution in the United States, the element of mutuality inherent in the composition of the Associations (which embraces the whole spectrum of ship-owning activities, and not only the operation of oil tankers) is upset. Their Reinsurers, and consequently the Associations themselves, have therefore been compelled to examine their liabilities in respect of pollution risks carefully, bearing in mind all the other liabilities (*e.g.*, for personal injury and death, cargo loss and collision damage) which may stem from the same casualty. It is for these reasons that the maximum coverage the Associations and their Reinsurers are able to provide in respect of any insured vessel, for all oil pollution claims, both Governmental and private, arising out of a single incident, is \$14,400,000 (£6,000,000), and in some instances the available coverage is substantially less.

In the case of a large tanker of 60,000 gross tons, the Association with which the tanker is entered will have issued a certificate of insurance on a form approved by FMC in the amount of \$6,000,000 (\$100 multiplied by 60,000 tons), as the evidence of financial responsibility of the owner or operator required by W.Q.I.A. Even if the Association were called upon to pay the United States Government the full \$6,000,000 under such a certificate, there would still remain insurance coverage of \$8,400,000 available to meet liabilities to all other oil pollution claimants, including any foreign governments, any states or municipalities, and any private interests.

In the case of most ocean-going vessels, there is at present no policy limit applicable to liabilities arising out of pollution by other substances. The Associations are still able to obtain reinsurance in much greater amounts against liabilities other than for oil pollution, firstly, because at present the owner or operator is not liable for pollution by other substances in the absence of fault, and secondly, because where the fault is not his own personal fault, but that of the vessel's master or crew, his liability is limited, under the United States Limitation of Liability Act. Title 46 U.S. Code §§ 183-89, to an amount equal to the value of the vessel plus the earnings of the voyage on which the casualty occurred, and under the 1957 Brussels Limitation of Liability Convention, where it applies, to approximately \$67 per ton of the vessel's "limitation" tonnage.

THE EFFECT OF SECTION 8 OF S. 523

If enacted into law, Section 8 of S. 523 would impose absolute liability, without regard to negligence or willfulness, upon the owner or operator of the vessel from which a hazardous polluting substance was discharged, for any damages, including removal costs, resulting directly or indirectly therefrom. For example, the owner or operator would be liable, even if the discharge resulted from the Government's own negligence.

If Section 8 were construed so as to impose liability in an unlimited amount (as well as absolute liability) for accidental discharges of hazardous polluting

substances from vessels, the liability would be uninsurable to the extent that it would be unlimited. This would be so because the Associations' Reinsurers would then insist upon imposing a ceiling on their coverage which would not exceed, and would in all probability be substantially lower than the ceiling presently applicable in oil pollution cases.

If federal legislation were enacted imposing absolute unlimited liability in respect of pollution by hazardous substances, a substantial number of vessel owners and operators who are members of the Associations could not afford to take the risk of trading their vessels to United States ports. For example, before attempts at enforcement of the Florida Oil Spill Prevention and Pollution Control Act¹ (which purports to impose absolute and unlimited liability) were halted by the issuance of a temporary restraining order, certain owners and operators were declining to permit their vessels to trade to Florida, primarily because they could not afford to risk incurring liabilities in amounts for which they could not obtain insurance.

"Tough" federal legislation will not prevent any accidental discharges, and will only result in a diminution in maritime trade with the United States. Such legislation will undoubtedly increase substantially the cost of transportation of many of the commodities the public wants and demands, without any commensurate benefit whatsoever.

LIABILITY FOR THE DISCHARGE OF HAZARDOUS POLLUTING SUBSTANCES COULD BE INSURED WITHIN THE SCOPE OF W.Q.I.A.

W.Q.I.A. effectively amended the Limitation of Liability Act so as to create a special "limitation fund" of \$100 per gross ton (subject to a ceiling of \$14,000,000) available only to the United States Government for oil removal costs. The owner or operator of an oil tanker trading to the United States is therefore potentially liable up to the aggregate amount of two "limitation funds", i.e., (1) the special fund of \$100 per ton available to the Government alone for oil pollution cleanup costs, and (2) the basic "limitation fund" available to all other claimants under Title 46 U.S.C. §§ 183-89, consisting of an amount equal to the value of the vessel plus the gross voyage earnings (subject to the proviso that if the personal injury and death claimants' share of the fund so computed is less than \$60 per ton of the vessel's adjusted gross tonnage, that share must be increased to that amount.)

It is believed that reinsurance would be available to cover the liability of a vessel owner or operator for the cost of cleaning up discharges of hazardous polluting substances in addition to oil, if Section 11 of the Federal Water Pollution Control Act as amended by W.Q.I.A. (which S. 523 would redesignate as Section 12) were amended so as to include hazardous substances as well as oil, with the same limitation on liability (\$100 per gross ton, with a ceiling of \$14,000,000) and the preservation of the same defenses (act of God, act of war, negligence of the Government and act or omission of a third party), whether the incident resulted in the discharge of oil or other hazardous polluting substances, or both. If the total limit of liability for any one pollution incident were increased beyond these figures, then reinsurance would not be available to the extent of the increase.

The many thousands of certificates of insurance which the Associations have already issued to FOM under W.Q.I.A. (at an enormous expenditure of time and money by the Government, as well as by the Associations and the vessel owners and operators) could then, by agreement, be deemed endorsed so as to cover liability for discharges of other hazardous polluting substances besides oil. The result would be that vessels carrying hazardous polluting substances, such as liquid chemicals in bulk, would be placed on a parity with vessels carrying oil, in respect of liabilities for the cost of cleaning up accidental discharges. If this were done, it is believed that it should be possible to maintain coverage in respect of all claims arising out of any one pollution incident at \$14,400,000. Since the announced object of S. 523 is to improve the quality of the waters of the United States, there is no logical reason for differentiating between liability for the accidental discharge of oil and liability for the accidental discharge of other hazardous polluting substances.

¹ Chapter 70-244, Florida Laws of 1970.

If pollution by hazardous substances were treated in the same manner as pollution by oil under W.Q.I.A., the liabilities would remain insurable, and ships would therefore continue to trade with the United States at reasonable rates, carrying the products the American taxpayers demand. Legislation imposing uninsurable liabilities, on the other hand, would provide no corresponding benefit to the public or improvement in the environment.

Respectfully submitted,

NICHOLAS J. HEALY,
JAMES J. HIGGINS,
GORDON W. PAULSEN,
Attorneys.

The following communication and attachments supplied for the record by the subcommittee staff:

MAY 12, 1971.

Mr. LEON G. BILLINGS,
Professional Staff Member, Senate Committee on Public Works, Subcommittee on Air and Water Pollution, U.S. Senate, Washington, D.C.

DEAR MR. BILLINGS: Thank you very much for your letter of April 21 concerning the Subcommittee on Air and Water Pollution plans for hearings on ocean dumping legislation.

The Department of State will not submit a statement for the record. However, I am enclosing for the Committee's information two statements by the Legal Adviser, Mr. John R. Stevenson, on the ocean dumping legislation before the Congress. I trust these statements will be useful to the Committee in indicating the Department's concerns regarding the jurisdictional and international legal aspects of the proposed ocean dumping legislation.

If you have any further questions regarding this matter, please contact Mr. F. Allen Harris, Special Assistant to the Legal Adviser. He can be reached on 632-9417.

Sincerely yours,

DAVID M. ABSHIRE,
Assistant Secretary for Congressional Relations.

Enclosures.

STATEMENT OF THE HONORABLE JOHN R. STEVENSON, THE LEGAL ADVISER, DEPARTMENT OF STATE BEFORE THE SUBCOMMITTEE ON FISHERIES AND WILDLIFE CONSERVATION AND THE SUBCOMMITTEE ON OCEANOGRAPHY OF THE COMMITTEE ON MERCHANT MARINE AND FISHERIES, HOUSE OF REPRESENTATIVES, APRIL 7, 1971

Messrs. Chairmen and committee members, I appreciate this opportunity to meet with you to testify in support of the President's proposal to control ocean dumping. I would like to discuss with the Committee the jurisdictional aspects of the Marine Protection Act of 1971 (H.R. 4247 and H.R. 4723) and the international efforts of the Administration to protect the marine environment.

The Marine Protection Act of 1971 has been carefully drafted to maximize United States control over ocean dumping activities consistent with accepted principles of international law. In this connection, I wish to note the fact that to our knowledge all dumping off our coasts at present originates from the United States and that we have no reason to believe the situation will change. I would like to briefly discuss the relevant principles of international law on which the President's ocean dumping proposal is based.

Traditionally, the law of the sea has been faced with two fundamental problems—defining the extent of coastal state jurisdiction over the ocean and accommodating conflicting uses of the high seas. Although we continue to work on several aspects of these problems, great advances were made in 1958 with the adoption of the four Geneva Law of the Sea Conventions. These Conventions codify the existing international law of the sea and established several important new international legal principles. These Conventions, to which we and many other nations are parties, establish the present legal basis for coastal state control of ocean activities.

The Convention on the Territorial Sea and the Contiguous Zone provides, in its first article that the sovereignty of a coastal state extends beyond its land territory to its territorial sea. With the exception of the right of innocent passage through the territorial sea, the United States under this Convention and customary international law enjoys complete control over all activities in our 3-mile territorial sea.

Furthermore, this Convention provides that a coastal state in a zone of the high seas contiguous to its territorial sea may exercise control necessary to prevent the infringement of its customs, fiscal, immigration or sanitary regulations within its territory or territorial sea. The Convention specifies that this contiguous zone may not extend beyond 12 miles from the coast. Thus, within the contiguous zone, the United States can enact measures to prevent unlawful pollution of its territory or territorial sea. It is important to bear in mind that United States authority under the Convention does not derive from a right to prevent pollution of the contiguous zone as such, but from a right to prevent pollution of our territory or territorial sea.

A state, of course, has jurisdiction over vessels flying its flag on the high seas irrespective of their location.

A state may also determine the conditions under which materials may be removed from its territory, and specifically has the power to prohibit such removal by its own or foreign nations and vessels. But, beyond 12 miles, a state has no rights under international law to regulate the activities of foreign vessels on the high seas in the absence of an international agreement. The Convention on the High Seas is explicit on this point; Article 2 *inter alia* provides that:

The high seas being open to all nations, no state may validly purport to subject any part of them to its sovereignty.

Article 6, *inter alia*, provides:

Ships shall sail under the flag of one State only and, save in exceptional cases expressly provided for in international treaties or in these articles, shall be subject to its exclusive jurisdiction on the high seas.

The Administration's proposed Marine Protection Act of 1971 establishes control over the transportation of material by any person from the United States for dumping on the high seas; it also establishes control over the dumping of material by any person from any source in the 3-mile territorial sea of the United States and in the additional 9-mile contiguous zone adjacent to its territorial sea. Both provisions would apply to American and foreign nationals and vessels. We believe this is the proper exercise of our jurisdiction under international law, and fully meets all cases of dumping arising now or likely to arise.

As there is legislation before this committee to control ocean dumping on the basis of our jurisdiction over the continental shelf, I would like to briefly discuss the legal problems inherent in that approach. Under the Convention on the Continental Shelf, the United States has exclusive sovereign rights for the purpose of exploring the continental shelf and exploiting its natural resources.

The Convention does not give the United States sovereignty over the continental shelf for all purposes, and it explicitly preserves the status of the superjacent waters as high seas. The drafters of the Convention carefully considered what rights and obligations necessarily flowed from the general right of the coastal state over exploration and exploitation, and were quite explicit. The coastal state, for example, has a right to erect installations and exercise jurisdiction over them for the exploration and exploitation of natural resources, and establish safety zones around the installations. It has certain rights over research undertaken on the shelf and has an obligation to prevent unjustifiable interference with other uses of the sea. Nowhere does the Convention authorize the coastal state to regulate dumping. Indeed, it is the Convention on the High Seas, not the Continental Shelf Convention, which specifically refers to the dumping of radioactive wastes. It is clear that the Geneva Conventions consider that dumping should be treated under the high seas regime, that is by regulation of one's nationals and by international agreement.

In this connection, we must also consider the question of enforcement. The basic principle regarding vessels on the high seas is that they are subject to the exclusive jurisdiction of the flag state except as otherwise agreed. There is no treaty giving the United States authority to arrest a foreign vessel on the high seas for dumping.

Thus, legislation regarding dumping activities on the high seas above the continental shelf would amount to a unilateral assertion of jurisdiction by the United States without a firm basis in international law, and in derogation of certain general principles of international law. Such an assertion would be contrary to our established policy of opposing unilateral claims as a means of solving high seas problems, could result in protests by other states, is unnecessary to meet the immediate problems off our coast, and is particularly unnecessary in the light of the fact that the prospects for effective international action under United States leadership are quite good.

The accommodation of various uses of the high seas, as I mentioned earlier, has been a fundamental issue in the development of the law of the sea. Article 2 of the High Seas Convention provides *inter alia*:

The freedoms [navigation, fishing, laying submarine cables and pipelines, flying over the high seas] and others which are recognized by the general principles of international law, shall be exercised by all states with reasonable regard to the interests of other states in their exercise of the freedom of the high seas.

It is clear that dumping must be conducted with reasonable regard for the interests of other states in their exercise of the freedom of the high seas. This obviously includes the protection of the high sea environment and its fisheries and living resources. It can be anticipated that a future treaty on dumping is likely to place very heavy emphasis on the need to protect the common interests states have in preservation of the marine environment.

What I would like to emphasize is that we cannot unilaterally resolve these marine pollution problems by extending our jurisdiction in violation of accepted principles of international law. We must resolve these problems multilaterally and we are presently working to do so in several forums.

The Preparatory Committee for the 1973 Law of the Sea Conference has charged one of its three sub-committees to work on the problem of marine pollution. I expect this committee to produce treaty provisions for the 1973 Law of the Sea Conference establishing international protection for the marine environment. In this connection, I had the honor to serve as United States Representative to the Preparatory Committee for the Law of the Sea Conference last month, and specifically suggested ocean dumping as one aspect of the marine pollution problem that required international action. I am certain the Committee will be pleased to note that the United States was the first country to present such proposals to the Preparatory Committee for specific action to combat marine pollution. With your permission, I would be pleased to make copies of our recent statement in the Preparatory Committee available to this Committee.

President Nixon's proposals regarding the seabeds beyond the limits of national jurisdiction are also relevant. The Draft Convention on the International Seabed Area submitted by the United States as a working paper last August to the UN Seabeds Committee provides that "all activities in the International Seabed Area shall be conducted with strict and adequate safeguards for the protection of human life and safety and of marine environment." The draft contains regulatory provisions to further these ends and contains provisions for compulsory settlement of disputes. Accordingly, international means would be available to insure that all seabed activities, including dumping, are conducted in agreement with the requirement that there be strict and adequate safeguards for the protection of the marine environment.

An international Working Group on marine pollution has been established by the Preparatory Committee for the 1972 United Nations Conference on the Human Environment. The Working Group will prepare a marine pollution agenda submission for the Conference which will probably include proposals that nations ban the dumping of certain harmful substances in the oceans and adopt systems for the regulation of ocean dumping.

Work is also underway in the NATO Committee on the Challenges of Modern Society and the Intergovernmental Maritime Consultative Organization. The latter is preparing for a 1973 Conference to ban all international discharges into the seas by ships of oil, oily wastes, and other noxious substances.

Accordingly, I am confident that in the next few years we will see major international developments banning the ocean disposal of toxic industrial wastes, highly radioactive materials, heavy metals, chemical warfare agents, and the setting of international standards to prevent damage to the marine environment from exploration and exploitation of the seabed.

I strongly urge the adoption of this comprehensive ocean dumping bill—the Marine Protection Act of 1971—as an important first step to effective international control of the universal problem of marine pollution.

Thank you very much. I will be happy to answer any questions you may have.

STATEMENT OF THE HONORABLE JOHN R. STEVENSON, LEGAL ADVISER,
DEPARTMENT OF STATE

Mr. Chairman and Committee members, I appreciate the opportunity to testify in support of the President's proposal to control ocean dumping (The Marine Protection Act of 1971 (S. 1238)). The focus of my testimony this morning will be on the jurisdictional aspects of this legislation and the international efforts being undertaken by the Administration to protect the marine environment.

The proposed Marine Protection Act of 1971 has been carefully drafted to maxi-

mixe United States control over ocean dumping activities consistent with accepted principles of international law. I would like to discuss briefly these international law principles.

Traditionally, the law of the sea has been faced with two fundamental problems—defining the extent of coastal state jurisdiction over the ocean and accommodating conflicting uses of the high seas. Although we continue to work on several aspects of these problems, great advances were made in 1958 with the adoption of the four Geneva Law of the Sea Conventions. These Conventions codified the existing law of the sea and established several important new international legal principles. These Conventions, to which we and many other nations are parties, establish the present legal basis for coastal state control of ocean activities.

The Convention on the Territorial Sea and the Contiguous Zone provides in its first article that the sovereignty of a coastal state extends "beyond its land territory and its internal waters, to a belt of sea adjacent to its coast, described as the territorial sea." With the exception of the right of innocent passage through the territorial sea, the United States under both this Convention and customary international law enjoys complete control over all activities in our 3-mile territorial sea. Furthermore, this Convention provides that a coastal state in a zone of the high seas contiguous to its territorial sea may exercise control necessary to prevent the infringement of customs, fiscal, immigration or sanitary regulations within its territory or territorial sea. Article 24 of the Convention specifies that this contiguous zone may not extend beyond 12 miles from the coast. Thus, within this contiguous zone, the United States can enact measures to prevent unlawful pollution of its territory or territorial sea. It is important to bear in mind that United States authority under the Convention does not derive from a right to prevent pollution of the contiguous zone as such, but from a right to prevent pollution of our territory or territorial sea.

A state, of course, has jurisdiction over vessels flying its flag on the high seas irrespective of their location. A state may also determine the conditions under which materials may be removed from its territory, and specifically has the power to prohibit such removal by its own or foreign nationals and vessels.

Beyond 12 miles, a state has no rights under international law to regulate the activities of foreign vessels on the high seas in the absence of an international agreement. The Convention on the High Seas is explicit on this point; Article 2 begins by stating that:

The high seas being open to all nations, no state may validly purport to subject any part of them to its sovereignty.

Article 6, in relevant part, provides:

Ships shall sail under the flag of one State only and, save in exceptional cases expressly provided for in international treaties or in these articles, shall be subject to its exclusive jurisdiction on the high seas.

The Geneva Conventions consider that dumping should be treated under the high seas regime, that is by regulation of one's nationals and by international agreement. In this connection, we must also consider the question of enforcement. The basic principle regarding vessels on the high seas is that they are subject to the exclusive jurisdiction of the flag state except as otherwise agreed. There is no treaty giving the United States authority to arrest a foreign vessel on the high seas for dumping.

With these legal principles in effect, it is important that our national ocean dumping legislation be carefully drafted so not to purport to regulate high seas activities of foreign flag ships. S. 1062, another ocean dumping bill also under consideration by this Subcommittee, is so broadly drawn that it may be subject to international misunderstanding as the bill appears to control ocean dumping on the high seas irrespective of whether the materials being transported for ocean dumping originate from territory under U.S. jurisdiction. We may exercise control only over dumping occurring in waters under our jurisdiction, over the transportation for dumping of material from territory under our jurisdiction, or over ships of our registry.

The Administration's proposed Marine Protection Act of 1971 establishes control over the transportation of material by any person from the United States for dumping on the high seas. In this connection, I wish to note the fact that to our knowledge all dumping off our coasts at present originates from the United States and that we have no reason to believe the situation will change. The Act would also establish control over the dumping of material by any person from

any source in the 3-mile territorial sea of the United States and in the additional 9-mile contiguous zone adjacent to the territorial sea to the extent dumping in this contiguous zone may affect the territorial sea or territory of the United States. Both the provision on transport for the purposes of dumping and the provision on dumping in the territorial sea and contiguous zone would apply to American and foreign nationals and vessels. We believe this is the proper exercise of our jurisdiction under international law, and fully meets all cases of dumping arising now or likely to arise.

The accommodation of various uses of the high seas, as I mentioned earlier, has been a fundamental issue in the development of the law of the sea. Article 2 of the High Seas Convention provides in part:

The freedoms [navigation, fishing, laying submarine cables and pipelines, principles of international law, shall be exercised by all states with reasonable regard to the interests of other states in their exercise of the freedom of the high seas.

It is thus clear that ocean dumping must be conducted with reasonable regard for the interests of other states in their exercise of the freedom of the high seas. This obviously includes the protection of the high sea environment and its fisheries and living resources. It can be anticipated that a future treaty on dumping is likely to place very heavy emphasis on the need to protect the common interests states have in preservation of the marine environment.

What I would like to emphasize is that we cannot unilaterally resolve these marine pollution problems by extending our jurisdiction in violation of accepted principles of international law. We must resolve these problems multilaterally and we are presently working to do so in several forums.

The Preparatory Committee for the 1973 Law of the Sea Conference has charged one of its three sub-committees to work on the problem of marine pollution. I expect this committee to produce treaty provisions for the 1973 Law of the Sea Conference establishing international protection for the marine environment. In this connection, I had the honor to serve as United States Representative to the Preparatory Committee for the Law of the Sea Conference last month, and specifically suggested ocean dumping as one aspect of the marine pollution problem that required international action. Mr. Chairman, you will be pleased to note that the United States was the first country to present such proposals to the Preparatory Committee for specific action to combat marine pollution. With your permission, I would like to make copies of our recent statement in the Preparatory Committee available to this Committee.

President Nixon's proposals regarding the seabeds beyond the limits of national jurisdiction are also relevant. The Draft UN Convention on the International Seabed Area submitted by the United States as a working paper last August to the UN Seabeds Committee provides that "all activities in the International Seabed Area shall be conducted with strict and adequate safeguards for the protection of human life and safety and of the marine environment." The draft contains regulatory provisions to further these ends and contains provisions for compulsory settlement of disputes. Accordingly, international means would be available to insure that all seabed activities, including dumping, are conducted in accordance with the requirement that there be strict and adequate safeguards for the protection of the marine environment.

An International Working Group on marine pollution has been established by the Preparatory Committee for the 1972 United Nations Conference on the Human Environment. The Working Group will prepare a marine pollution agenda submission for the Conference which will probably include proposals that nations ban the dumping of certain harmful substances in the oceans and adopt systems for the regulation of ocean dumping.

Work is also under way in the NATO Committee on the Challenges of Modern Society and the Intergovernmental Maritime Consultative Organization. The latter is preparing for a 1973 Conference to ban all international discharges into the seas by ships of oil, oily wastes, and other noxious substances.

Accordingly, I am confident that in the next few years we will see major international developments banning the ocean disposal of toxic industrial wastes, highly radioactive materials, heavy metals, chemical warfare agents, and the setting of international standards to prevent damage to the marine environment from exploration and exploitation of the seabed.

In closing, I would like to mention briefly the proposed "National Oceanic and Environmental Research Act of 1971". There clearly is a need for an effective pro-

gram, both within the United States and internationally, of oceanic and environmental research to provide the basic information which will enable the development of effective national and international regulations to protect the marine environment. The Department of Commerce, through NOAA, already has substantial authority to conduct such research which would support the EPA's proposed ocean dumping regulatory activities. We would defer to those agencies as to the need for and the appropriateness of the authority which S-307 would provide.

I believe that the Administration's ocean dumping bill—the Marine Protection Act of 1971—is an important domestic first step which will lead to effective international control of the universal problem of marine pollution. I strongly urge the adoption of this comprehensive ocean dumping bill.

Thank you very much. I will be happy to answer any questions you may have.

ADDITIONAL INFORMATION

Materials below are referred to at close of hearing. See page 2175.

[From the Cape May County Gazette]

ANOTHER COASTAL TRAVESTY

News dispatches from Philadelphia last week reported plans to barge some 3½ million gallons of highly toxic chemical wastes from an impoundment area along the Delaware River in Bucks County to a site approximately 47 miles off the coast of Cape May where it will be dumped in the ocean.

According to the reports the plan was conceived by the Army Engineers of the Philadelphia district in the hope of averting further pollution of the Delaware River if the earthen dikes containing the impoundment should deteriorate further and permit the chemical wastes to seep or gush into the river.

The action followed a similar dike breakdown several weeks ago which permitted vast quantities of oil and other wastes to flow into the Schuylkill River causing a great deal of additional pollution and costing a tremendous amount of money to clean up the mess in and around Philadelphia.

All of this appears to be just fine for Philadelphia if everything works the way it's supposed to . . .

But what about Cape May and Cape May County? What about the additional pollution that this special dumping will cause in the ocean? What about the threat to our resort beaches? What about the coastal ecology?

Despite the enactment last year of federal laws to protect the environment, despite a presidential edict prohibiting the dumping of oil and other wastes into the ocean and any other navigable waters, despite the hullabaloo that followed the Navy's recent dumping of bilge oil into the ocean off Florida and all of the other senseless and needless oil spills that have wreaked havoc along most of our shores, the Army Engineers continue to consider the ocean not only as a cesspool for the sewage of metropolitan areas but as a public dump for anything that anyone wants to get rid of.

Coming in the midst of Cape May County's own battle to try to halt the dumping of Philadelphia's sewage sludge less than six miles off our coast, this latest travesty by the Army Engineers should call for a top level investigation and a complete shake-up of the Corps of Engineers which is specifically charged with stopping pollution and protecting the total environment.

When any governmental agency can thumb its nose at the President, at Congress and at the people it is supposed to serve and continue in direct violation of the laws it is supposed to administer . . . and the laws of a badly trammelled nature . . . it is high time for a thorough housecleaning and for some brass hatted heads to roll.

Toward that end, we demand—requesting obviously does no good—that New Jersey's Congressional delegation, Senators Case and Williams, Congressman Sandman and all the others in the House of Representatives representing this state, call upon the President to launch an immediate investigation of this whole sorry picture and let the chips fall where they may.

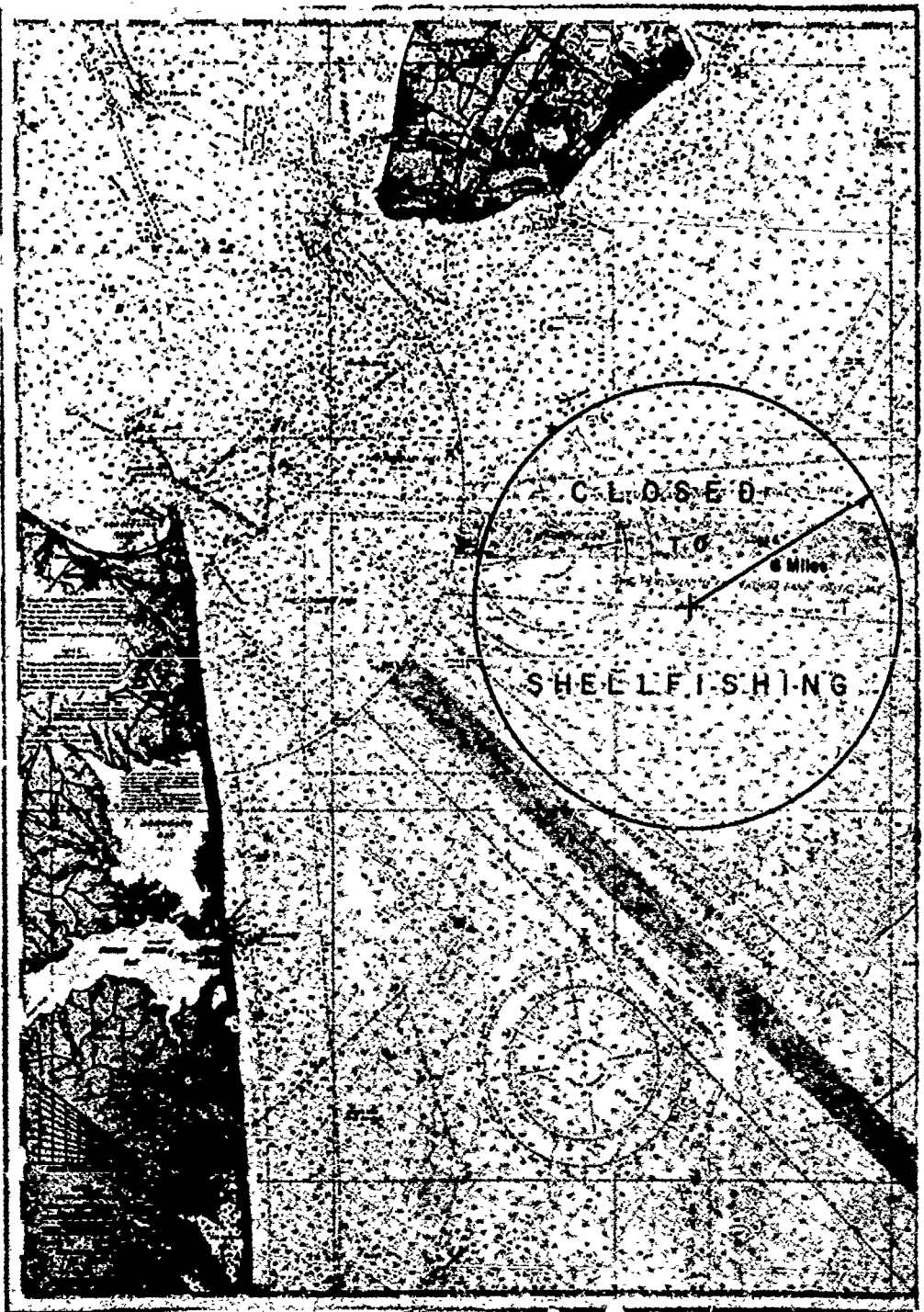
The recent fiasco with the Coast Guard refusing to protect a seaman who was seeking political asylum off Cape Cod showed clearly that the President can raise hell with the military on rare occasions. Two hastily retired admirals can attest to that. And that was only an isolated case involving one foreign seaman . . .

We submit that in the case of the Army Engineers who have notoriously flouted the law and on innumerable occasions have failed to discharge their statutory responsibilities, as witness the case in point, there should be a Congressional hearing going far beyond any self serving military court martial to make some of these overpaid and underworked puppets of a military bureaucracy account for some of the mistakes they have made and are continuing to make.

If a mistake in judgment can result in the Coast Guard dumping two admirals over the plight of one foreign seaman think how the brass should be tarnished if the Army Engineers were ever required to face up to some of the mistakes they have made affecting whole regions, millions of people and billions of dollars! There would be a trail of scrambled eggs and military medals from the Aleutians to the South Pole 'cause these boys are no pikers when it comes to making boobies.

And that is precisely what we demand our Congressional delegation insists on . . . a full Congressional hearing on some of the colossal blunders the Army Engineers have committed. Cape May County alone has enough evidence of their mistakes, wrong guesstimate and failures to perform their assigned duties to cause the whole untouchable and elite Corps of Army Engineers to topple from its self made pedestal. Every other state in the union has similar examples of its ineptitude—enough to scuttle the whole stupid bunch of 'em.

But for openers we point to the dumping of sewage sludge and this latest plan to dump highly poisonous industrial wastes into the ocean a short distance off our coast and we defy the Army Engineers and the bureaucrats who protect them to try to justify either one in terms of law, environmental protection or common sense.



**It Can Be Stopped! It MUST Be Stopped
NOW! If Our Fishing, Clamming And Resort
Industries Are To Survive!**

BEST COPY AVAILABLE

Ocean disposal as of October 30, 1970, by company and material

Dupont-Edgemoor—Acid waste.....	gallons--	67, 584, 000
Dupont-Chambers Works—Industrial sludge.....	do----	1, 699, 572
Rohm & Haas—Arsenic solution.....	do----	2, 500, 000
Rohm-Haas—Arsenic compound	tons--	698
Rollins & Purle—Acid waste.....	gallons--	4, 453, 368
Philadelphia, Camden & Bridgeton—Sewage sludge.....	do----	182, 556, 380
Gulf Oil—Industrial waste.....	pounds--	13, 000

STATEMENT OF JACK GORDON FISHERIES

JACK GORDON FISHERIES,
Wildwood, N.J., March 16, 1971.

To whom it may concern:

As manager of Jack Gordon & Son Fisheries, Inc., I have been asked to report on the status of the commercial fishing industry in Wildwood, New Jersey.

In year of 1958 we had a total of 31 commercial fishing boats operating from our dock in Ottens Harbor, Wildwood, New Jersey. Since year 1962 there has been a sharp decline in the amount of fish produced, and a gradual decline of fishing boats to 3 boats, and is doubtful as to how long they can continue.

In talking with the Captains of these boats, they seem to think that the blame lies in the sewage dumping and other contaminated cargo. I believe there is something that depletes the production of fish in this area and will eventually close our business.

Most likely the suspect is in the dumping of sewage sludge.

Respectfully yours,

JACK GORDON & SON FISHERIES, INC.,
EDWIN R. ANDERSON, *Manager*.

STATEMENT OF JOHN C. JENSEN, FISHERMAN

As one of the oldest active commercial fisherman in this area, I have been asked to write about what has happened to the fishing ground known as the Channel.

The channel starts at the mouth of Delaware Bay about 7 miles east of Rehoboth, Del., and goes seaward to the southeast for about 12 miles. The average depth of water is about 50 or 60 ft. except a deep slough that gets as deep as 150 ft. in places. This slough runs the entire length of the ground.

When I started fishing in 1932 this ground was our best and most prolific spot for summer fluke, porgies, and sea bass and continued until 1962. Since 1962 a gradual decline has taken place where it is useless to go to this ground and expect to find a day's pay.

This ground in 1962 supported 40 to 50 boats day after day, as it has done for many years. It was without a doubt, the best and most productive place for fluke on the Atlantic Coast. The channel ground has deteriorated so bad that last year (1970) the most boats that I saw were 4 and they were only hunting. They failed to find any amount of fluke and soon left for other grounds, hoping to find better fishing.

It is my opinion and the opinion of all the other fisherman that I have talked with, that the main reason for the failure of this fine fishing ground can be traced to the dumping of sewage sludge, acids and other contaminating wastes.

It is my firm belief that, if all waste dumping in the ocean is not stopped very soon all fishing on either side of the Delaware Bay will be a thing of the past.

JOHN C. JENSEN.

STATEMENT OF CAPTAIN C. N. SHOFFLER

10 years ago at Lorain position 3H4 3422, 3H5 3152, a one by two mile area was designated for dumping of sewage sludge. Since this time, a six mile radius from this point or a hundred and twenty sq. miles has been condemned for shell fishing.

This area was closed by Chief North East Technical Service, F.D.A. It was deemed necessary to close this area because of e'coli, or caliform counts. Caliform is only from warm blooded animals, in this case, human waste.

Due to lax and haphazard methods of dumping, no surveillance, and without benefit of buoy systems, this area has spread and become a dead and unyielding ground, because of continual short dumping.

Fish catches in 1969 and 70 are down to 1/10 of the catches for 1960. Sea bass, once abundant in these slews from May to Oct. are no longer in these slews. Flounder that once came 1 to 3 miles south of this area in May and June, and returned in Sept. and Oct., no longer migrate to these outer shoals. The same conditions are prevalent with lobsters, and sand crabs, also rock crabs.

This area was picked by the city of Philadelphia, without the Hydrographic or Oceanographic knowledge of any organization learned in these Sciences. These shallow water slews, with an average depth 60 feet, with an average depth of 40 feet on the outer banks are needed for the reproduction of all food fish that enter the estuaries of our bays and back bay waters. These species include Sea bass, flounder, scup, and lobster. Said area is also 70% clam bottom of this 40% is need clam ground. It could be clammed extensively 7 months a year.

Due to my 25 yrs. experience of fishing and clamming commercially owning and operating my own boats for 20 yrs., I have become familiar with the prevailing tide and wind patterns in this area.

If dumping of sewerage sludge is allowed to continue it will certainly go to the beaches of South Jersey and Delaware, as it has to the beaches of the New York bight.

Also it will continue to draw heavily on the oxygen which reaches it's lowest ebb in the warmer summer months.

This can be confirmed by such persons in the Sciences as:

Dr. Jack Pierce, Sandy Hook Lab.

"Sewerage sludge does nothing in the way of fertilization to the benthic community.

"In the warm summer months oxygen counts are down. Too low to sustain life of microflora."

Captain James L. Verber, USPHS Chief Northeast Technical Service Unit, Food and Drug Admin.

"Did you note, and I'm sure all of you have, the six mile radius on this map, just out of my office? Why is it six miles from the dump area is only one by two? It's because of no surveillance of the dumping. Perhaps our northeast storms or other types of storms, where it is difficult to navigate out in the ocean, they might not even get to sea. We don't know."

Barry Commoner, Director, Center for the Biology of Natural Systems, Washington Univ., St. Louis, Mo.

"It has been estimated that by 1980 in absence of drastic action to change our method of sewage disposal, the organic wastes imposed by human activity on the waters of the United States will require for their decomposition all the oxygen contained in all the river systems of the nation in the summer months."

Respectfully,

Capt. C. N. SHOFFLER.

STATEMENT OF DR. HAROLD H. HASKIN, NEW JERSEY SHELLFISH RESEARCH,
RUTGERS UNIVERSITY

In our group, about 20-odd years ago, we've done some hydrography in that area, studying the current patterns, bottoms situation and so on for the U.S. Navy as part of its general East Coast program on Anti-submarine Defense. At that time it had been determined that in terms of the flow of water in and out of the bay the major part of the salt water that came into the bay was coming in around the tip of Cape May. The major portion of the fresh water is coming from along the Delaware shore, so that if one were picking the site in which to dispose of materials that one didn't want to get back in shore, the place one would not put this would be toward the Cape May side, because here you have the return currents that's coming in along the bottom bringing the salt to the bay.

STATEMENT OF RICHARD E. BELLIS, NEW JERSEY STATE DEPARTMENT OF
ENVIRONMENTAL PROTECTION

(*Spistula Solidisma*.) The surf clam, the sea clam, the ocean quahog, whatever you want to call it, it's out there and it's being dredged up and we're producing the most of the beast throughout the country. What's happening now is the dumping area for sewage sludge is doing a two-fold job. It's creating a toxicity problem or a potential health hazard, and it's at the same time creating an elimination of the species in the area which is being blanketed by this sludge. So we're losing ground on both aspects. It's become necessary for the safety of the consuming public to close an area around this dumpsite. This is a very significant area. It's better than 100 square miles involved. At the same time we're here trying to solve this, the dumping goes on and the species is endangered because it is being blanketed and smothered basically.

STATEMENT OF CAPT. OTTO STOCKER

Mr. Chairman, I present testimony from Kenneth Hand, who has been dragging approximately twenty years in the area. He says that at the time he started there were plenty of porgies, fluke and bass, in the past ten years there has been a rapid decline of the above fish. The dumping has caused a decline of the breeding.

Richard Stoz also a dragger of the past twenty-five years claims very good fishing in the condemned areas off New Jersey and Delaware, four or five years ago, especially in the summer season, but the last three years it has declined, particularly no fish. The commercial boats are about finished in the area.

Condemned area fishermen call this the radar buoy, mussel beds and this whole area is the dumping area.

They see the barges go by every day loaded and come back very light;

In this area according to the fishermen the mussel beds were the most productive, and it is now a dead area.

The party boatmen, the fishermen and draggers insist dumping on the shelf must be stopped.

The alternative solution recommended is under strict supervision and to be dumped over the Continental shelf—for a limited time only. All want NO ocean dumping.

These men feel that other States can't stop dumping for economic reasons, etc., but what about their livelihood, are they to be put out of business? Are they done due to dumping crap? They feel it is not only their living, but the wealth of the land being destroyed by poor planning.

The fishermen feel they can probably survive, but what about their children—who is the future generation.

Pollution ended the sword fishing business and this is a fact known by the fishermen. This may soon mean the end of all fishing.

In the area their nets come up with a black slime and it's impossible to wash it out, plus it is moving on to a larger area. It is now getting like a big black plague.

Some local fishermen claim they are dumping in the mouth of the Delaware Bay and this will cause great damage. This is a shallow area for spawning.

We feel we have been neglected by our elected officials, by not observing this in time to have avoided all this say the fishermen.

They feel this was one of the most stupid moves made by an intelligent person, to make this a dumping area.

Any move made to contaminate the water, the fishermen should have been consulted first. Then proper legislature would have been constructive.

Without the modern equipment costing many thousands of dollars, these fishermen would be out of business, due to the small amount of fish available.

There are about seventy men waiting at the docks, hoping the men have a good catch, as these in turn give them their living, also the trucks, gas and oil, ice, and fish dealers in the larger cities.

All officials should stop talk'ng, produce more, this is the general opinions along the docks.

Another type of fishing is Pot Fishing. #1 Decline in production per trap at least 500%—What one trap produced in 1930, it now takes a ten to equal—

Fish (bottom) will not stay and live on the dumping grounds for any period of time.

The mussel and clam bottom in the Center dumping area are now dead sludge, mud and plain filth. This as a trap fisherman, I can prove and I have been forced to find new bottoms.

I have tried some gear each year, but was very unsuccessful; we catch worthless crabs more than ever so they must be drowned by the sludge. Mussels will not spawn and grow in this area.

#2 This dumping is putting me as a seabass fisherman out of business. Railway and supplies are increasing in price and our production is very far down. Unless this disgrace to a brand new country is stopped we will be a bunch of ruined States. I have observed the slop barge discharging her cargo of filth many times. The ocean has turned black for miles and it is so heavy it appeared that you could walk on the surface of the water.

Capt. E. J. Weiderstrom says, "At one time we were 25 individuals of Sea Bass Trap Rigs from the Cape May Inlet—as now we are three. This alone speaks for itself. Those 20 that have been forced out of business means 20 boats. The economy of this great country unless this disgraceful dumping is stopped is going down the drain.

This drain will have to be handled as they do in the foreign countries—pressed into blocks and disposed or used in some other ways.

This if stopped now can be done and I feel the ocean of this wonderful country can be saved.

What are we going to leave our children?

In conclusion I, Capt. Otto Stocker, am speaking for the THOUSANDS of petitioners, fishermen, draggers, and party boat operators plus the Pot fishermen, docks, Marinas ETC. These fishermen would be sitting on the elected officials' doorsteps if it were not for the fact they have to go in any weather to make a living, so I was chosen to intercede for them.

These men are not belligerent and they would welcome representatives visiting them to get constructive ideas for good legislature.

I, Capt. O. Stocker, will be glad to make arrangements for interviews, should any person or committee desire.

We could go on for quite lengthy paper work pointing out the millions of dollars and thousands of dollars affected in fishing and boating.

The consensus of all persons is dumping over the Continental Shelf. At previous meetings boats have been shown to be available. There is no reason why there should be any delay in dumping over the Shelf.

This has been the thoughts of many men and their experiences. Among them: Capt. Elmer Weiderstrom, 40 years experience; Capt. Kenneth Hand, 25 years experience; Capt. Richard Stoz, 25 years experience; and Capt. Otto Stocker, representing many phases of Marine activities, 43 years.

WATER POLLUTION CONTROL LEGISLATION

Ocean Dumping

WEDNESDAY, JUNE 16, 1971

**U.S. SENATE,
SUBCOMMITTEE ON AIR AND WATER POLLUTION
OF THE COMMITTEE ON PUBLIC WORKS,
Washington, D.C.**

The subcommittee met, pursuant to recess, at 10 a.m., in room 4200, New Senate Office Building, Senator Thomas F. Eagleton (vice-chairman of the subcommittee) presiding.

Present: Senators Eagleton, Boggs, and Randolph.

Also present: Barry Meyer, chief counsel; Bailey Guard, minority clerk; Leon G. Billings, Richard D. Grundy, Richard W. Wilson, and Harold H. Brayman, professional staff members; and Tom Jorling, minority counsel.

Senator EAGLETON. Good morning, ladies and gentlemen.

The Senate Subcommittee on Air and Water Pollution of the Senate Committee on Public Works is now in session.

This is a continuation of hearings that were originally held on March 26 relating to ocean dumping.

We have one witness on the agenda this morning, and I would like to call on the Honorable Clifford Case, Senator from New Jersey, to introduce our esteemed witness.

HON. CLIFFORD P. CASE, A U.S. SENATOR FROM THE STATE OF NEW JERSEY

Senator CASE. Thank you, Mr. Chairman.

It has been a great pleasure for me to appear before this subcommittee, as it is always a pleasure for any Member to appear before this subcommittee, and especially this morning to appear in the spotlight that always shines on a matter of distinction of the witness that we have the privilege of hearing this morning, who is Dr. Jacques Piccard.

Dr. Piccard has indicated to this subcommittee the great interest and concern he has with the subject of ocean dumping, and, as you know, he is internationally distinguished, and an oceanographer, whose accomplishments are known the world over.

As you know, I am sure, Dr. Piccard is a Swiss citizen. He has spent a great deal of his time in Europe. He has contact in this country through a representative here with offices in Jersey City, N.J.

Through an article published, Dr. Piccard learned about legislation that I introduced which is pending before this subcommittee, and

other bills to control dumping of wastes in the ocean, and because of his interest in protecting the ocean, Dr. Piccard through his representatives in New Jersey, that is to say, in the United States, contacted my office to get more information about the bill, and to see what he could do about supporting its concepts. When my office informed him that this subcommittee planned hearings, he asked for an opportunity to appear.

Many of you know, of course, that Dr. Piccard was born in Belgium in 1922—he looks to me to be somewhat younger—but that is still the fact as I understand it.

His father, Prof. Auguste Piccard, was known for his explorations of the stratosphere in lighter-than-air craft and of the ocean depths in vehicles of his own design.

Dr. Piccard worked with his father in the design and operation of the first deep-sea-diving vessel, which they named the "Bathyscaph," from the Greek words meaning "deep ship."

The second underwater craft constructed by Dr. Piccard and his father was the *Trieste*, which ultimately was bought by the U.S. Navy.

Dr. Piccard piloted this ship, the *Trieste*, on 65 successive dives, the last of these voyages on January 23, 1960, made the recordbreaking descent to 35,800 feet in the Marianas Trench off Guam in the Pacific Ocean.

Dr. Piccard designed and built the *Ben Franklin*, a 50-foot, 130-ton steel research submarine. This ship was initially used for a 1,500-mile submerged drift in the gulf stream from Palm Beach, Fla., to Nova Scotia.

For his contributions, Dr. Piccard was awarded the Distinguished Service Award by President Eisenhower, the Theodore Roosevelt Distinguished Service Award, and the Argosy Magazine Giant of Adventure Award.

In addition to many technical papers, Dr. Piccard is the author of "Seven Miles Down," which is a popularized account of his experience with the *Trieste*, and earlier this year, "Sun Beneath the Sea," an account of the gulf stream, was published.

I take great pleasure and pride in presenting to this subcommittee Dr. Jacques Piccard.

I ask that a full statement of his background be inserted, if I may, in the record at this point.

Senator EAGLETON. Thank you very much, Senator Case.

The full biographical sketch will be inserted in the record, as you desire.

(The biographical sketch of Dr. Piccard follows:)

Dr. Jacques Piccard, born in Belgium in 1922, is a Swiss citizen and the son of the late Professor Auguste Piccard, who is best remembered for his exploits and explorations of the stratosphere in lighter-than-air craft and of the ocean depths in vehicles of his own design.

The scientist was educated in Brussels and then in Switzerland. He received a degree from the University of Geneva in 1946, and a year later was awarded a diploma from the Graduate Institute of International Studies there. He was also an assistant professor at the University of Geneva prior to 1950. In June, 1962, Dr. Piccard was awarded a Doctor of Science degree from American International College in Springfield, Massachusetts. In 1970, Hofstra University in Hempstead, New York, also conferred a Doctor of Science degree on him.

Together with his father, Dr. Piccard participated in the design and operation of the first deep diving vessel, which they named the "bathyscaph" from the Greek words meaning "deep ship". This vehicle, like its successors, operated independently and was not attached in any way to a mother ship, as were earlier oceanographic diving vessels. The father-son team first constructed the FNRS-2, which was later turned over to the French Navy, and then the *Trieste*, which ultimately was purchased by the U.S. Navy. Dr. Piccard piloted the *Trieste* on 65 successive dives. The last of these, on January 23, 1960, was the record-breaking descent to 35,000 feet in the Marianas Trench off Guam in the Pacific Ocean.

In 1963-64, Dr. Piccard designed and constructed the world's first mesoscaph or middle-depth vehicle for the Swiss Exposition at Lausanne. This 98-foot submersible was put into service as a tourist submarine and carried more than 30,000 passengers on over 1,100 dives while in Lake Geneva.

In 1966, a five-year consulting contract with Grumman Aerospace Corporation of Bethpage, New York, was followed by the announcement in October that Grumman and Dr. Piccard would collaborate in the building of a new submersible, the PX-15, later christened the *Ben Franklin*. This 50-foot, 130-ton steel research submarine was initially used for a 1500-mile submerged drift in the Gulf Stream from Palm Beach, Florida, to Nova Scotia. With Dr. Piccard and five companions, the *Ben Franklin* served as a platform from which the scientists performed acoustic, marine biological, chemical and related deep ocean experiments.

For his contributions to oceanographic science, he was awarded the Distinguished Service Award by President Eisenhower, the Theodore Roosevelt Distinguished Service Award and the Argosy Magazine Giant of Adventure Award.

In addition, he has received the Richard Hopper Day Memorial Award of the Academy of Natural Sciences of Philadelphia; honorary memberships in the "Institut Suisse Architects Navals" and "Societe Helvetique des Sciences Naturelles." He is a life member of the National Geographic Society and holds the Drexel Institute Engineers' Day Award. Dr. Piccard is the author of many technical papers and a popularized account of the *Trieste* entitled "Seven Miles Down", co-authored by Robert S. Dietz. His account of the Gulf Stream Drift Mission, "Sun Beneath the Sea", was published in 1971. The Swiss explorer speaks French, English, German and Italian. He makes his home in Lausanne, Switzerland, with his wife and three children.

Senator EAGLETON. Senator Case, we are indeed pleased to have you here, especially on this occasion to introduce this illustrious witness.

Senator CASE. The chairman is most kind; and my only regret as to this morning's proceedings is that now I have to go to New Jersey. You can imagine, gentlemen, how difficult it is to be torn between great satisfactions one derives from a visit to New Jersey and of listening to a person as eminent as Dr. Piccard.

The only consolation I have is that I shall be able to read in the record his testimony, ~~and~~ and I leave him in the hands of people who I knew not only appreciate the great experience and privilege we have this morning, but who have enormous capacity for hospitality.

I give to you Dr. Piccard.

I thank you for being here, Dr. Piccard, and we recognize the enormous

Senator EAGLETON. Thank you, Senator.
mous work that you have done.

Dr. Piccard, you may proceed in your own way.

STATEMENT OF DR. JACQUES PICCARD, RESEARCH OCEANOGRAPHER, LAUSANNE, SWITZERLAND

Dr. PICCARD. Gentlemen, I am very much impressed to be here. It is a very big honor for me.

I would like to tell you that my children also were very much impressed when I told them I had to testify in the American Senate, and they asked me if the American Senators used to wear the purple toga as the Romans once did.

I especially, of course, appreciate the fact you have invited me to testify on the subject of ocean dumping. As you know, I am working in the field of the oceans and the seas for over 20 years now, and I have traveled over many seas, and I have dived in many of them—at one time down to the deepest place in all the oceans.

I am involved with deep-sea research and have built three scientific submersibles, which have been acquired by American public or private organizations.

In my oceanographic efforts, I have worked and exchanged views with many practical and theoretical ocean scientists; these activities have led me to the following conclusions, all of which are consistent with the spirit of the various bills presently being discussed in this subcommittee:

1. The sea is the richest mine in the world.
2. The sea produces two-thirds of the oxygen we breathe.
3. The sea absorbs a good part of the excess of carbon dioxide in the atmosphere.
4. The most vital and critical element for this sea activity is called phytoplankton, or very tiny sea plants.
5. This phytoplankton is also the first element in the food chain in the ocean.
6. If the phytoplankton were to die, the totality of life in the sea would disappear and most probably mankind would soon start to suffocate from lack of oxygen and excess of carbon dioxide.
7. This phytoplankton is presently in peril; it is endangered by many forms of ocean dumping.
8. In many phytoplankton forms, scientists are now finding high concentrations of pesticides, herbicides, and oil components, much of which is thought to be carcinogenic in nature.
9. Thus, ocean dumping must be strictly controlled and I am obviously in favor of your various bills.

But what would be the use of the United States renouncing to dump wastes in the sea if other countries will be allowed to jettison oil and other poisons 3 miles from your shores?

This points up that ~~national ocean dumping~~ is only a part of the danger that we have to face and that the responsibility of the people governing the principal powers of the world is immense.

There are people who believe that the problem is so big that the probability of solving it is very remote. Let me give you a few considerations.

1. The major problem of ecology is the fact that the basic laws themselves are not yet understood or expressed. Let us imagine a chemical plant employing 10,000 workers, fabricating products that everybody considers to be dangerous, but which are still used because they have some direct utility, such as insecticides, for example.

The plant is also polluting the air and water with its byproducts and wastes.

In its total production, direct and indirect, it is dangerous to mankind.

Still, the plant cannot be closed, as it provides 10,000 jobs.

Ten thousand people cannot be thrown out into the streets, even if we could very coldly consider the situation; 10,000 unemployed people would increase the poverty of the country and also multiply faster than 10,000 rich people would.

This ultimately would require more food and more insecticide to produce it.

2. In the big cities of the world there are always wide areas of poverty and slums.

The tendency is always to produce low-rent apartments as a better way of life for these poor people.

But in doing this the main result is to attract more people to the cities; to have the cities grow more and to enlarge the problem instead of reducing it.

The pride of being a big city is the best example of the blindness of mankind; the big cities are just now starting to show how mankind may die.

3. Solutions which appear good in the short term may be disastrous in the future.

Insecticides which saved millions up to now but endanger mankind for the next generation are a good example.

Governments should have the courage to explain the truth to their people and to prepare and enforce unpopular measures.

In particular, people have to be prepared to make drastic collective and personal sacrifices.

For example, private transportation and personal comfort may soon have to be severely reduced.

4. I am not speaking only for this country, but for the whole world, and mainly for the big, industrialized nations.

It is obvious that no country can ameliorate the situation only by itself.

The danger is for all mankind. Thus, the first step is an accord between the principal powers of the world, and mainly the United States, Russia, Great Britain, the Common Market countries, and Red China.

This understanding is a sine qua non condition of survival for mankind.

5. A common vocabulary—I mean a clear definition of the ecological terminology and its problems—as well as universally recognized standards and norms have to be defined and accepted by everyone.

An international data center for pollution and ecology has to be created; it has to profile the air we breathe, the soil we exploit, the food we eat, the water we drink, and so on.

6. A long-term ecological program has to be created for meeting every decision we make, development of our cities versus welfare projects, agriculture versus mining, soil erosion and roadbuilding, pesticide uses, powerplants versus air and water pollution.

And even the aid to underdeveloped countries, which so often starts from such a generous spirit, but which could have just an effect opposite to the goal.

If this aid is not applied under a general ecological philosophy, the danger is to export to other countries the virus of a perilous aspect of our civilization.

Right now, underdeveloped countries probably have a more promising future than we so-called advanced nations have.

7. Finally, over everything else, I would like to mention that even the old myth of progress and development has to be completely re-discussed and redefined.

The question for mankind is no longer to progress; it is to survive.

And progress today may signify disaster and death tomorrow.

There are many examples of animal species destroying themselves when they became too numerous. What makes a major distinction between other animals and man is man's capability to foresee and anticipate further and better than other living species.

But this capability gives him the responsibility to avoid disaster. And as members of the Government of one of the most powerful nations in the world, your responsibility is awesome.

You have various ways to act, and these proposals to ban ocean dumping are a step in the right direction.

But the task is infinitely greater.

Now, while striving for an international understanding on ecology, nothing should prevent you from organizing a powerful agency here in this country.

Only a unique organization can do the job, something combining the ability and skills and scope of a NASA with a powerful, autonomous Government agency with financial support greater than anything we know up to now.

This might turn out to be the condition of mankind's survival.

It is in your hands.

Again, I thank you, gentlemen.

Senator EAGLETON. Thank you very much, Doctor.

We sincerely appreciate your appearance, the thoughtfulness of your presentation.

I have a series of questions, which I think I will just ask one or two of, Doctor, and I will yield to the chairman of the committee, Senator Randolph, who has now joined us, and to Senator Boggs.

Doctor, on one or more points in your statement, you talked in rather grim terms, I might say, about, for instance, the question of survival of mankind. As you talked about it, the question for mankind is no longer to progress, but it is to survive.

Without trying to pin you down to a precise date, could I ask you this question in a general way: Assume that we continue to defile the oceans as we are now doing, and assume we keep dumping, and by we I mean the United States and the other industrialized nations that you mentioned, Japan, the Common Market countries, the Soviet Union, the Republic of China, and so forth, and, in fact, we not only continue to dump in the oceans, but we accelerate it. I think the statistics will show that more dumping goes on this year than last year, and there was more last year than in 1969, and so on.

Where are we heading in terms of a point of no return? That is, are we a decade away, half a century away from calamity, or how close may it be, as you view it?

Dr. PICCARD. Let me just first remind you that, as I told you, one of the main problems is that the general aspect of all of this question is not very well known up to now, so every calculation, every projection that we could make about this problem, is not absolutely sure up to now.

We cannot guarantee anything; however, people who have studied the question, as much as possible up to now, consider it, if we just continue as we are doing now, and accelerating it as we are accelerating it, the danger to mankind will come within 30 to 50 years.

Senator EAGLETON. If we continue at our present rate, as it accelerates each year?

Dr. PICCARD. And at that time, 30 years from now, the population of the world will be something like 6 billion to 7 billion people, and it would just collapse completely, down to a few hundred million people, and if the population folds in a few years, or a few months, from 6 billion or 7 billion to a few hundred million, complete civilization would be destroyed, nothing would be working on, and the people remaining would be living in an extremely primitive way like those a thousand years ago.

Senator EAGLETON. Doctor, I will yield at this time to Senator Randolph of West Virginia.

He has another commitment that he must fulfill in about 20 minutes or so, and I will yield to him at this time.

Senator RANDOLPH. Thank you, Mr. Chairman.

Dr. Piccard, you have a significant heritage; you follow a great father, and both you and your father have been concerned with the problems of the degradation of the earth. This permits me to say that you are a family that has given very considerable study to environmental problems, and your recommendations are not only of significance, but of help to the subcommittee.

I felt, Mr. Chairman, that this might be the appropriate time to call attention to some other comments on ocean disposal that I ask be made a part of the record.

We have in our Public Works Committee record, a report of the Council on Environmental Quality. This group has come forth with a report on the subject of ocean dumping and the need for a national policy.

Now, that report was issued last October. Subsequently I requested a group of our advisory panel to the Committee on Public Works to give a critique on those findings.

The finalization of the critique was just forwarded to the committee by Dr. James R. Arnold, the dean of scientists and professors of chemistry at the University of California in San Diego.

The critique was prepared by the committee's panelists and scientists of the Scripps Institute of Oceanography of La Jolla, Calif. Prof. James Arnold being the chairman, Prof. Robert Curry, Prof. Rolf Eliassen, Prof. Gene Likens, and Dr. George Woodwell and several others.

There were scientists also cooperating from Scripps. As a byproduct partially of this effort, there is pending before the Committee on Foreign Relations, Senate Joint Resolution 80, which I introduced on April 1 of this year.

This resolution would call for an international conference on ocean dumping in 1971. There are 29 cosponsors who have joined with me, the able Senators Eagleton and Boggs being two of that number.

We had felt, Dr. Piccard, that such a conference could well be held, in fact it needed to be held, prior to the broader environmental conference of the United Nations in 1972, on the general subject of the nature of man and his ability to work with nature, rather than to disrupt it.

Now, the advisory panel's critique contains several criticisms of the CEQ environmental report and recommendations for research. I think, Dr. Piccard, it is important, that while you are a witness, you would comment on certain questions that have been raised and highlighted by the thinking of these professors.

Now, in particular the critique says that the CEQ report states most dredge spoils are now deposited within a few miles of shore in less than a hundred feet of water.

The report implies, and other individuals have suggested, that ocean dumping beyond the Continental Shelf would not provide pollution problems.

Is there any scientific basis in your opinion, Dr. Piccard, for believing that deep-ocean disposal will avoid the pollution problems that currently are stemming from ocean dumping?

Dr. PICCARD. Well, it is, of course, a very important question to see where we have to dump things in the sea, and where it is the least dangerous.

It can be on the Continental Shelf, or after the Continental Shelf, that is, on the slope in deep water.

There are two aspects.

If anything is dumped close to shore on the Continental Shelf, wastes, or anything, all of this will just come back to the shore and make the shore dirty—this is one aspect.

Even if the shore is dirty, it does not mean it is destroying the environment.

What is important to know, if we dump this material, this waste in great depths, what will happen there.

Will it stay there, or will it not stay there, and it can disappear for two major reasons.

One, it can just become a part of the water, and it can just soil the water, or it can also go very far away due to currents.

There are underwater currents even in great depths. We saw very important currents at a depth of 1,500 feet, so it does not mean that because we are far away from the shore, or because we are beyond the Continental Shelf, that there is no current, and that the things will just stay there.

These can just go everywhere in the ocean, so I believe that the most important question is to know whether the products we are dumping in the ocean are dangerous or not by themselves; and if they are dangerous, where we put them in the sea, they can gradually diffuse and go everywhere, so I do not believe even dumping in the sea very far away is the solution.

We have to get rid of this matter, and we have to see how, and this is a part of many, many aspects of ecology.

We have no longer a choice of doing something dangerous or doing something not dangerous.

We have a choice between various solutions, and we have to decide which ones are least bad of all.

Senator RANDOLPH. Are you saying, in essence, that ocean dumping, regardless of where the dumping takes place, does have a deleterious effect upon the waters?

Dr. PICCARD. Probably, yes.

Now, we could find places in very deep water, where there is probably no current, where probably the sedimentation would fall, and where we can expect this would be buried forever; but we do not know yet enough of these problems, and presently I would recommend not to dump anything in the sea, but unfortunately, the practical problems of ecology are such that we do not know what else to do with the wastes.

Senator RANDOLPH. Well, there are quantities of waste, Dr. Piccard, that enter into the oceans by many means. We know that, and those sources are other than just ocean dumping; is that not correct?

Dr. PICCARD. Yes. You mean just going into the rivers and so on?

Senator RANDOLPH. Yes.

Dr. PICCARD. But we have to make a very important distinction. If it is normal sewage water, it might not be very dangerous.

If it is chemical products, like detergents, oil, then we have to be much more careful, and maybe we could introduce distinction between the various kinds of products, and some we would allow to be dumped in the deep water, and just not allow others to be dumped in deep water at all.

Senator RANDOLPH. Mr. Chairman, I ask permission to have you, Senator Boggs, or another of our colleagues, to ask three additional questions on my behalf because of my time problem. Before doing that, I ask unanimous consent to include as part of today's hearing the advisory panel critique of the Council on Environment Quality report.

It was originally prepared for committee use but it is very searching. I think that it does belong in this record, not just as an insert, but as material that will be valuable in providing a good record in these hearings.

Senator EAGLETON. It will be made a part of the record.

(The report follows:)

CEQ REPORT CRITIQUE

I. INTRODUCTION

While the CEQ report is a useful first effort, your panel has found many things to criticize, as the following discussion will make clear. It may be useful at the start to state our own working philosophy. It is conservative. That is, we wish doubts always to be resolved in the direction of safety, given the interconnections and concentration mechanisms of the world ocean system, about which we already know, and for which there still remain immense gaps in our factual knowledge and our understanding. There are many lakes and rivers, and their waters are renewed on a relatively short time scale, providing the absence of large disturbance. There is only one world ocean system, and it must last the life of the earth.

In a larger sense the ocean is only one major component of man's natural environment. While it may be administratively convenient to divide problems into physical space (air, rivers, ocean, etc.), or political region, these problems truly interconnect.

One additional general point is that it would be good to set a world example on policy of waste disposal in the environment that could be presented at the 1972 United Nations meeting at Stockholm to serve as guidelines for other nations.

II. CRITICISMS

In the CEQ report there is an emphasis throughout, usually implicit, sometimes explicit, on the areas important for commercial fisheries, oyster beds, etc. There is a consistent lack of concern for the world oceans. This comes out in the recommendations as well as in the text (a glaring example can be seen in the proposal on page 24, dumping farther out to sea.)

The assumption that dumping further out to sea alleviates the problem of waste disposal is faulty. The ocean, despite its size, is an interconnected system. The connections are partially due to currents and mixing but for the types of pollutants that are of most concern to man the most important connections are biological. There is no part of the ocean, with the possible exception of totally oxygen-free basins, that does not have a considerable variety and number of organisms living in it and passing through it. This has been shown even for the bottom of the deep sea by the pictures taken by J. D. Isaacs' ⁽¹⁾ "monster camera" which show large numbers of active predators and scavengers attracted to baits and by the quantitative studies of Hessler and Sanders ⁽²⁾ which have shown that there is abundant and diverse fauna living on and in the upper few inches of the bottom sediment.

All organisms that have been studied have shown considerable capabilities for concentrating materials—heavy metals, chlorinated organic compounds, etc. Thus, a concentration in the water that is of no importance in itself can become dangerously high in an animal or plant living in that water. This effect is often multiplied as one goes up the food chain toward top predators. These are not only the most active species, and thus generally wide ranging, but also the ones that man hunts. Many of the economically more important ones live primarily in the surface waters or in shallow water but they are connected to the deep water forms by the phenomenon of vertical migration which is practiced by large numbers of species at nearly all depths. Thus it is ridiculous to believe that once a pollutant is out of sight in the deep sea, it will be out of the interconnected biological systems that affect man.

Besides the scientific principle explained above, there is a political principle also, that it is illegitimate for the United States to trespass on the waters belonging to all mankind in the absence of a world agreement covering these matters. Until that comes about all ocean disposal by the U.S. should be within the territorial waters of the U.S. This is a minimum interim measure. We are not here ignoring the interconnections described above. The question is a moral and political one.

Another essential fact is the dearth of knowledge about the deep oceans. It is a major error to add a dangerous quantity to a natural system that is not understood.

The CEQ report includes nothing about controlling ocean dumping by U.S. agencies abroad. This includes U.S. industries and the armed forces. Regulations that apply to U.S. based industries should also apply to the foreign branches of these industries. Ocean disposal controls should also apply to the military, both domestically and overseas. This includes the military in Vietnam with its haphazard spraying of herbicides, lead (bullets), and other persistent chemicals.

The recently passed legislation on oil pollution included an interesting concept. If oil is dumped in international waters by a U.S. vessel but ends up on territorial waters or coastline, then that vessel is liable for damages. Perhaps this precedent can be applied to the disposal of wastes in the ocean.

A serious gap in the CEQ treatment on inputs of artificial material into the oceans is that it makes no attempt to include continental effluents (rivers, rain run-off). It is widely recognized that U.S. rivers act as primary carriers for wastes transported to eventual dumps in the sea. The U.S. should attempt to control the transport of these water-borne wastes from its ports and territorial waters. For this we need guidelines for allowable concentrations of substances in river-borne marine effluents. This is the largest single class of ocean dumping, yet is largely ignored in the CEQ report. Existing legislation does not address itself to this problem and source directly. We emphasize that the CEQ report is incomplete without at least a call for this legislation.

The recommendations are full of such phrases as "phasing out," "stopped as soon as possible," and "interim programs." Even if the research needed to find solutions is funded, the whole history of government regulation shows that these phrases are full of possibilities for endless delays. A more specific approach, now being attempted in the case of auto exhaust controls, is worth considering. This is to set legislative deadlines, perhaps five or six years ahead, beyond which the undesirable practice will not be permitted. This makes the incentives for industry in the direction of the solution of the problem rather than in the direction, proven so successful in the past, of lobbying for delay.

It is our feeling that the following materials should cease to be disposed of in the ocean immediately (2 years) :

1. toxic metals*
2. Polychlorinated biphenyls
3. chlorinated hydrocarbons (general class of which 2 is special)
4. large amounts of organic solids & liquids that would cause a drastic alteration in the chemical & physical properties of receiving area
5. high level radioactive wastes
6. chemical-biological warfare agents
7. other toxic substances*

The following should not be dumped within five years: 1. Polluted dredge spoils that when dumped in receiving waters would cause a major change in properties of the area.

It is of paramount importance that any accounting of the research needed to investigate a given problem be concise, accurate, and display intelligence and judgment about the system(s) it is working with. The CEQ report has failed this test in the area of research needed to study and define the present and future effect of ocean dumping on the global environment. Our main specific criticisms are listed below followed by a sketch (Section III) for an alternate "Research Needs" section of our own design.

A. Disagreements in "Research Needs" section:

1. Lacking in detail about specific research, funding agencies, regulatory agencies, mission agencies.
2. Is concerned only with mission-oriented research and not with the equally important fundamental work needed to understand this complex system that we are disturbing.
3. Does not seem to understand that research should involve all major components of the nation's research capacity, in and out of government. There are many reasons, and many historical examples.
4. Overall tone of section is too simplistic.
5. There is no attempt to give a financial estimate for appropriations needed to fund the needed research. It is our feeling that a suitable sum of money would be in the range of 50 million dollars yearly for research (exclusive of demonstration plants and other forms of "development").
6. It is obvious that a well-coordinated and directed national monitoring program is required. The CEQ makes no mention of this.
7. While the CEQ report discussed alternatives to ocean dumping in some detail, there is no adequate attention to this major field in the research section. While we omit this area in the following draft, because of our lack of competence as a panel in this area, we wish to call attention here to this deficiency. Obviously if wastes are not to be dumped in the ocean, practical alternatives must be provided. Research will be needed in disposal technology and related areas.

With any regulatory effort there should be a consideration of the question "who will watch the watchman?" Under our present system, outside of a few volunteers like Ralph Nader, the only recourse is Congress. The Joint Committee on Atomic Energy provides an interesting case history. While their supervision of the AEC has not always been constructive, and in the McCarthy era was very much the reverse, it has been very useful in the long run. Perhaps some similar procedure could be devised in the environmental area. Also, provision should be made in any legislation on ocean disposal for "citizen suits" that gives any citizen of the U.S. the power to bring suit against polluters or against the EPA if the Agency is not regulating ocean waste disposal as prescribed by law.

*Administrator shall consider toxicity of substance and degradation products and possibility of biological concentration.

III. ALTERNATIVE SECTION ON "RESEARCH NEEDS"

Since the greatest criticism of the existing section on "Research Needs" is its generality and incompleteness, this revised section is a sketch for a more complete document:

A. It is evident that a major research effort is required to improve our knowledge about the effect of wastes on the marine environment. For any large reman's waste materials into the ocean) but also to fund multidisciplinary studies discipline studies (such as the effects on marine population due to dumping man' waste materials into the ocean) but also to fund multidisciplinary studies that try to understand the ocean from a broad perspective. We must remember that in order to study the alteration of something, we need to know its original state. To use the terminology of ecosystem biologists, we need to understand the natural fluctuations of the complex parameters of our ocean environment (such as natural influx rates of nutrients, population densities, temperature changes, rates of removal, etc.) as an essential part of our knowledge of causes and effects in the area of human intervention.

To do this it is not enough to study the effects of ocean-dumped materials on a specific bay or estuary or ocean. At the same time we must have "pure" research in the field and laboratory on such things as natural fluctuations of surface- and sea floor-dwelling populations, natural fluctuations of temperature in marine environment, concentration factors and mechanisms of transport in marine and terrestrial food chains, sediment transport in marine environment, sea-air interface, etc. All fields of oceanography must be included (biological, physical, chemical) in single and multi-disciplined investigations due to the complexity of the system. Many of these questions have both short-term and long-term aspects; both must be considered.

B. Concurrently with this program, research must be conducted on the effects of human intervention. This should include all of, but not only, the following:

1. Quantification of amounts and routes of wastes going into the ocean with detailed chemical, biological and physical descriptions.

2. Study of the "stable" waste reservoirs. In other words, where are the long-term sites for the "dumped" material?

3. Investigation of the effects of the dumped material on the long-term reservoirs of the ocean. To do this, some type of monitoring program should be set up to do detailed and extensive investigations of several parameters in given areas. This monitoring program should also be implemented in other areas for reasons given in (A) and also in order to practice a little preventive surveillance of easily disturbed parts of the ocean. The program should be managed by EPA, but critically and frequently reviewed by outside experts.

4. The interaction of dumping with other man-made changes in the ocean, particularly its exploitation for food (fisheries, oyster beds, etc.), offshore oil production and marine transport of oil, and developing utilization of marine mineral resources.

C. The lead agency in this area will be the Environmental Protection Agency. The Agency will be expected to carry out research in its own laboratories, but to place strong emphasis on the support of research efforts in universities and other institutions, whose human resources are far larger and more diverse than those available in-house. This includes the funding of research by scientists in other countries, where this is the best way to get the job done. Certain special areas, as noted below, may best be dealt with by other agencies.

1. The overall level of funding for research, excluding engineering development, demonstration plants, etc., should be programmed to reach about \$50 million annually within a few years. Perhaps 40% of this should be spent within the agency, the rest outside.

2. In the case of universities, the mutual influence of research, graduate training, and other teaching must be provided for. There should be a modest fellowship program. Interdisciplinary efforts involving collaboration across departmental lines should be encouraged, but not the proliferation of new "institutes" for fund-raising purposes. Small grants for individual research can be very effective, and it is possible that this portion of the program is best administered by NSF.

3. The research areas should include, in addition to those discussed in (1) and (2) above, engineering research on possible new or improved disposal practices, studies in law and social science on the effectiveness of various

forms of legal and administrative control, and research on the international and supranational aspects of these problems.

4. In addition to an annual report of the director of EPA, including the areas of research and development, there should be close and continuing liaison between the agency and the appropriate committees of the Senate and House, to insure the most effective influence of new scientific knowledge on the legislative process, and the best guidance of the research effort in areas vital to public welfare. Legislative language similar to that in the atomic energy area may be appropriate here.

5. There should be annual or biannual forums to bring together small numbers of working scientists and politicians to foster the interchange of ideas, data and problems. Recommendations and legislation could be proposed and debated in these "workshops". This would also provide a direct mechanism for maintaining "relevancy" in the research. I think this should also be tied to frequent (2-3 times per year) site visits by the administrators and politicians.

REFERENCES

- (1) J. D. Isaacs, Scripps Institute of Oceanography, La Jolla, California
Personal Comments.
- (2) Hessler and Sanders, 1969, "Ecology of Deep-Sea Benthos", Science 163, 1416-1424.

FINAL COMMENTS

The purpose of the present document is to provide a working guide to the legislative staff and to committee members on the areas in which the CEQ report on Ocean Dumping appears to us deficient or in error. We have not attempted a unified treatment on the scale of the report itself, though we hope that an improved version of the original report can be prepared before long. We hope that these pages can be useful in the process of legislation in this essential area.

Individual comment:

METCALF & EDDY, ENGINEERS, INC.,
Palo Alto, Calif., April 30, 1971.

DR. JAMES R. ARNOLD,
Department of Chemistry, Revelle College,
University of California, San Diego, La Jolla, Calif.

DEAR JIM: I was hoping to see you in Washington this week at the NAS Meeting. The opening session was quite unusual because there were three members of the National Academy of Engineering addressing a scientific group on the problem of energy in the future. This involves our problem with the Senate Committee on Public Works.

To comment on your letter of April 19, I must first say that *the* critique is excellent. It hits the right spots just hard enough to make the Senate staff sit up and take notice.

My comments are as follows:

1. I like your concept of the "only one world ocean system" as opposed to the renewability of many lakes and rivers. However, the ocean itself is very renewable as evidenced by the activities at the sewage outfalls in Santa Monica Bay and off San Diego. I am not sure that you can draw a hard line as you seem to have indicated here. I agree with you that we cannot do irreparable damage to the oceans; neither can we do the same to the rivers or lakes. The important thing is the interconnection of all of the systems and you have brought this out.

2. On the bottom of page 2 I question whether all ocean disposal by the U.S. should be within the territorial waters of this country. If you can define territorial waters the way Ecuador and Peru do it, this is fine, but if you insist on a 3-mile or a 12-mile limit, we may be in trouble. I believe that all countries have certain rights to the great depths of the ocean and that certain decisions have to be made by the United Nations or a similar group.

3. On page 3 you mention that United States-based industries should be bound by our regulations even though they practice in foreign areas. I think that there would be quite a legal problem in the interpretation of this so I would not get involved with this. The statement about Vietnam is rather weak and really does not add much to our report.

4. At the bottom of page 3 you get into the question of pollution-carrying capacities of rivers which discharge into oceans. I am not sure that the existing legislation does not address itself to this problem and thus I would tone down this latter part of the last paragraph and probably try to mesh it with other legislation.

5. On the middle of page 4, why do you specify "organic mercurials"? I think that the microorganisms present in the ocean, particularly the benthic organisms are capable of converting inorganic mercury compounds to methyl mercury. The very next item, "high organic solids and liquids" is too ambiguous because it does not really specify what you mean. If you were to carry this to an obvious conclusion, it would mean that the City of Los Angeles could not discharge its sludge 7 miles out to sea because I would call that rather a high organic solid level. Also, "polluted dredge spoils" is very vague. The Corps of Engineers must be able to discharge the dredgings of the various rivers, such as the Hudson River, into the ocean. These are materials which ordinarily would be going to the ocean, but in the course of slowing down the velocities of the rivers, the suspended particles have settled in the navigable water channels and must be removed. Therefore, I think that this item is not well chosen. Similarly, the following item, "all nontoxic solid wastes" is too general. It means that we can dump nothing into the ocean, even concrete from the demolition of buildings in the event that they want to build breakwaters or other types of water control facilities. It is too general a statement and must be qualified or removed.

6. I agree with you most heartily on all of your statements under item A on page 5. It is just so appallingly evident that we need more important fundamental work, particularly after having listened to some of the people at Scripps. The figure of \$50 million is probably okay, although it should really go higher than this because oceanographic research is so expensive. We really want to look at the depths between 10,000 and 15,000 feet.

7. I question whether we want to give Ralph Nader any credit. So much of his stuff is really belligerent rather than constructive. This is raising a red herring in the Congress and there is no need for doing that.

The rest of the report is excellent. My only question is whether the EPA is the only agency which should be involved inasmuch as there is so much oceanographic work to be done.

Sincerely yours,

ROLF ELIASSEN.

Senator RANDOLPH. Finally, Dr. Piccard, what is the nature of the funding that will be necessary, as you see it, from either one source or many sources brought together, to clean the oceans? Is it possible to clean the ocean? Shall we say, of the present problem of pollution; or at least the problem that continues for a few years?

Dr. PICCARD. To clean the ocean is just impossible. We can just hope that nature will after a certain number of years, or centuries, it will just clean the water by itself, but we cannot expect to clean the ocean.

We can expect to stop making it more dirty, but we cannot expect to clean the ocean. It is already a matter, wherein the ocean, in every kind of water, there are insecticides, pesticides—all of these products are everywhere in the water, and even thousands of miles from the places where they are used, like the South Pole area, you find those, and the damage done cannot be repaired.

Senator RANDOLPH. Mr. Chairman, this final comment. Even though you have said we cannot clean the oceans, you do feel an organization such as you are heading, the work of the Congress and the administration, all of us within our governmental establishments including our peoples, other countries, political subdivisions, that they should all press forward and do what can be done?

Dr. PICCARD. Do what can be done, exactly, stop to pollute the ocean, and even this is extremely difficult, and this is one of the goals we can hope to reach, provided we are willing to pay the price for it, and this will be the same organizational order of magnitude as the budget for defense, for instance.

It will need something like this. We cannot expect to spend less money than this if we want to make good progress in this field.

Senator RANDOLPH. Thank you, Dr. Piccard, and, thank you, gentlemen.

Senator EAGLETON. Doctor, let me see if I understand the basic point you are making before this subcommittee.

Are you telling us you think there ought to be an absolute, total, across-the-board ban on all forms of ocean dumping?

Are you saying there ought to be prohibition of ocean dumping; meaning that certain highly dangerous substances, such as mercury—and you could add many to that list—ought to be absolutely banned from ocean dumping?

Is my question clear to you?

Dr. PICCARD. Ideally, of course, which would be no dumping at all, but even the word “dumping” is not quite clear.

Dumping usually refers to a boat going to sea and opens the hull and drops a lot of things in the ocean.

Dumping is also done through the rivers, through pipelines going over the Continental Shelf, and there is an important kind of dumping by the air.

A great part of the sea pollution is coming from the air.

When smoke goes into the air from smokestacks, the atmosphere becomes loaded with chemicals, and also the atmosphere is loaded with lead from cars exhausts, and this lead is falling with the rain into the sea. So when we say we have to ban all kinds of dumping, it would mean to stop industry a hundred percent, which is, of course, impossible, as we are speaking now.

Senator EAGLETON. Let's narrow it down. We are not going to stop the rivers from flowing.

Let's take the most commonly thought of type of ocean dumping that comes to mind. Let's take what goes on in New York City. When you come from Kennedy Airport, and you come across the bridges, you see these big flatbottom barges going out the Hudson River. They are just loaded, just mountains of waste, beer cans, and garbage and old tires, and maybe some automobile wrecks. I don't know what all else goes on those things, but there are literally mountains of them, and you see these barges being hauled out to sea, and they are going to dump it in the ocean. Should that kind of dumping be absolutely prohibited regardless of whether it is 3 miles out, 12 miles out, or 100 miles out?

Dr. PICCARD. Ultimately, yes, of course; but if I say no, we ask at the same time—well, what do we do with these things?

Let's say for the people of New York, it is better to have this in the sea than in the street, but maybe for all mankind, it is better to have it in the street than in the sea. The problem is double.

It is easy to say no dumping at all, but where shall we put these things? It is a very, very broad and wide problem, and we cannot give any precise final answer just for the dumping, without considering the worldwide ecological aspects of the question, and again, this might be a good step to choose very carefully, what are the things which we dump into the ocean, and either through this barge, or through the river, certain products should be prohibited, like mercury, for one.

Senator EAGLETON. Would you spell out for us then a little bit further your list of things that you can think of—off the top of your head—that you would consider to be so dangerous that you would prohibit absolutely in any way, shape or form for dumping? What are some of the substances? You mentioned mercury and oil products.

Dr. PICCARD. Any and all oil products. Lead is dangerous. Insecticides, pesticides are dangerous. Asbestos, too, is undesirable. It is important, very important, to include asbestos. We discovered very recently that is a very, very dangerous product. And there are a lot of others, so maybe we should have someone formulate a list. Asbestos, as I say, should be prohibited from dumping, and obviously radioactive materials.

Senator EAGLETON. What about sludge?

Dr. PICCARD. Treated sewage, in one way, is not too bad, except for one thing, the phosphates.

Phosphates are contained in the artificial fertilizers and in detergents, and they are very difficult to remove from the treated water.

As a result, it gives an excess of fertilizer in the sea, and in some places, especially the lakes, for instance, the problem of phosphates, it is overfertilizing the lakes, and it produces too much seaweed, and this will prevent the other kind of life from surviving, and then you kill the lake completely.

In great quantity it can also do damage to the sea.

Senator EAGLETON. Would you absolutely prohibit the dumping of treated sewage sludge in the oceans a hundred miles out?

Dr. PICCARD. You know, again, I would say yes; but presently it is impossible, because I believe with treated sewage the best thing we can do now is put it in the oceans. We have to put it somewhere on the earth.

Senator EAGLETON. Not all treated sewage is being dumped into the oceans.

Some is being put in abandoned mine shafts. One whole county in Illinois, it must be a lovely place to live, but one whole county has been purchased by the city of Chicago to be a dumping ground of municipal wastes.

They bought a whole county?

Dr. PICCARD. Yes; but you have to be careful about the water, because the water, which will go through these areas, can be contaminated by the wastes themselves, so, again, we have to make a distinction between what is just unpleasant to the sea, or dangerous to the rivers, and what can be very dangerous are the poisons, so we have to be sure that there are no dangerous chemical products that will be put in. For example mercury will usually go through any kind of treatment, water treatment.

Senator EAGLETON. Is there a difference in terms of harmful effects between what I will call solid sludge versus liquid effluent?

There is a solid sludge that is scooped up after all of the primary and secondary treatment, and it can be put on a railroad car for that matter.

Dr. PICCARD. Yes.

Senator EAGLETON. Now, what that is, it is a sludge, and when that is dumped in the ocean, is that more dangerous?

Dr. PICCARD. It will probably be decomposed; but in any case, we could take the problem one step forward, and let's say there are all of the aluminum cans, there are hundreds of thousands of tons of aluminum thrown away like this, if we think about it, it is unnecessary.

We could very well use a glass bottle which can be reused.

Instead of cleaning the bottles, you can just put them back into the oven, and you get a new glass, and then you can have the same glass which is always circulating, and then there will be no more problem for the cans, and this is good for mineral water, beer, wine, oil, and many other things, maybe even for vegetables and preserves I think that could be done in glass, too.

However, we cannot forget another aspect, and it is so complicated, even if you take glass, and you put in into the oven, to make a new bottle, this needs a lot of energy, and energy is electric power, which is either obtained from a nuclear powerplant or regular powerplant, which means there is a heat pollution, or smoke pollution; so that the general balance of all of this has to be computed exactly, of what is the best finding for the earth, and so forth, and these calculations have never been done on a wide-scale aspect.

Senator EAGLETON. What about the dumping of nitrates; is that dangerous?

Dr. PICCARD. That is about the same as the one of phosphates.

Senator EAGLETON. I yield to Senator Boggs.

Senator BOGGS. Thank you, Mr. Chairman.

Dr. Piccard, we appreciate your appearance here today. I think the testimony you have given will make a great contribution to this subcommittee's understanding of the ocean dumping problem.

You mentioned in your statement that the sea is the richest mine in the world. I assume you had in mind the fact that the sea produces two-thirds of the oxygen we breathe, and absorbs a great part of the carbon dioxide in the atmosphere. Other than that, did you have any other considerations in mind?

Dr. PICCARD. Yes. Also of materials we speak of that we think of being produced in the oceans, which turns out to be important, and one product as magnesium, I believe something like 98 percent is coming from the sea that is used in your country, and take energy alone, much of it comes from the sea, and as the population is continuing to grow, as it is now, we really need the sea water to make fresh water, and practically speaking, every kind of element on the earth can be found also in the sea.

Senator Boggs. Thank you. I thought your statement should be enlarged because of the great significance the sea holds for humanity.

Many of the answers you have already given have touched on questions that I had in mind. But I would like to get back for a moment to the sewage sludge problem.

We have had testimony from individuals who argue that the dumping of sewage sludge into the ocean can serve as a food, fostering the growth of fish and plant life. Would you like to comment on that point of view?

Dr. PICCARD. Yes; you are right, it could help to grow fish in one place in the ocean, it is quite possible.

However, again, we do not as of this time dominate the science, and industry has not dominated the problem, and maybe every time we make a change, the natural ecological cycle will break, and if we break it, it might be finished.

You have to be very careful of this, and, again, if you would throw in the sea only old potatoes and kitchen wastes, and things like this, it is good for the fish, certainly, but along with this will come all sorts of poisons from industry, and this is reason for which we have maybe to try to find a way to separate these at the beginning, to prevent damage. And we must enforce laws which prevent any kind of poison material from going into sewage water.

Senator Boggs. There are a great many old automobile bodies that must be disposed of in this country. There is some talk that they should be placed into the sea, as a sort of artificial reef, a shelter and feeding grounds for fish. Do you have any comment on that concept?

Dr. PICCARD. Again, it is the same. We do not know what effect it will give. I believe in many cases, an artificial reef of old cars is good, at least in the conventional industrial viewpoint, but, again, we do not know if these cars do not contain various poisonous things like asbestos, and this might turn out to be a poison for the fish and may cause other disasters.

Senator Boggs. It might serve a short-term benefit.

Dr. PICCARD. Yes; it could be good in short term, but it may be bad in another way.

Senator Boggs. Your point is good.

Dr. PICCARD. Instead, for instance, of dumping so many cars in the sea, I visualize will come the time when the Government will say for the weekend nobody can use a car, and this will reduce pollution and just keep the cars for the doctors, police, and so on.

Senator Boggs. Thank you. Could you tell us something more about phytoplankton? Do they concentrate more on the Continental Shelf, or are they spread throughout the sea?

Dr. PICCARD. No, they are spread throughout the sea.

Senator Boggs. Could you tell us something about how they reproduce, and how they absorb carbon dioxide from the air?

Dr. PICCARD. This is called the photosynthesis, and it is a phenomenon, a way of life, for all of the plants, whether in the sea or on land, in meadows, everywhere, with the energy of the sun, they take the CO_2 and water, and they combine into sugar, for instance, which is the basic element for life, and these plants are doing this in the earth, and in the water, and it is done through the light from the sun, so there too, if we make the sea so dirty, that the light will not come in any more, then these plants will die.

They will die because they have no light, and this happens many times.

Senator Boggs. I hate to admit it, Doctor, but I have not yet read your book "Sun Beneath the Sea." But I want to.

Dr. PICCARD. If you wish, I will send you one.

Senator Boggs. Thank you very much.

The Gulf Stream is very important, I am sure, and the environment in our State of Delaware. From your trip following the Gulf Stream, can you give us any information on one or two highlights that impressed you relating to our inquiry today, ocean pollution?

Dr. PICCARD. In our case, we practically did not see any real pollution there. We were not equipped to detect water pollution. The phytoplankton was normal, not very abundant, but normal.

We occasionally saw some dirty things, beer cans a thousand feet deep, and so on, but it is not very bad.

It may have been just thrown by a surface boat, but not a real problem, but in other parts where we went very deep, the pollution has not reached that part, but in other parts near the surface of the sea, we found—and others have found—a lot of pollution.

For instance, it has been found that in three-quarters of the sea, the ocean water was so dirty that they could not use it to brush their teeth.*

Senator BOGGS. Thank you very much.

Dr. Piccard, I want to say again how much we appreciate your testimony here. This is very valuable testimony.

Dr. PICCARD. If you will allow me, if you would take ocean water samples, and make chemical analysis, you would find there, as everywhere else, mercury and other chemicals.

Senator BOGGS. Thank you.

Senator EAGLETON. Thank you, Senator Boggs.

Doctor, it has been reported by some Danish scientists that the Baltic Sea is already subject to severe oxygen starvation, that it is almost a dead sea, and it has also been reported that the North Sea is rapidly approaching the same state.

The question then is, do you share that analysis of the condition of the Baltic and the North Seas, and is there anything that can be done to redeem a sea that is "dead" or about dead?

Dr. PICCARD. Yes; but it is, of course, a very long procedure.

The Baltic Sea is a very, very closed sea. It has only a very small opening at the end for an exchange with the ocean, and does not have much depth; it is very, very shallow.

The entrance is just a few hundred feet, so it would take a long time for the Baltic Sea to take the form it had before, but if this is reduced, it would be through an exchange of water, so it would just contribute to make the ocean more dirty.

Now, in the North Sea, it is very much more open in several ways, for one thing, it has very wide openings, so if it is dirty, it will just exchange water with the others. But the Mediterranean Sea is also nearly completely closed, so it would probably die before the North Sea.

Now, in the North Sea, they have a lot of continuously growing industry and they are constantly pouring gasoline, oil, and so on, so that would be a source of dirty water for the surrounding oceans.

Senator EAGLETON. Well, that leads me then to my next question. Even assuming that we, the United States, by laws and regulations, did a very commendable effort in restricting ocean dumping—restricting it to an irreducible minimum of nondangerous substances—and we really did it on a first-class basis, if the other countries in the world, whether it be those on the Baltic Sea, Japan, big industrial areas, were not equally forward looking, progressive along these same lines, of course, we would still have a world problem. Therefore, what kind of international arrangements do you envision—have you thought out

*Thor Heyerdahl, "Ocean Pollution Observed by Expedition 'Ra.' "

the structure of what they could encompass in terms of international agreements, international policing, international enforcement?

Have you thought of it along those lines?

Dr. PICCARD. The political way to arrive to this, is, of course, not in the hands of the scientists; however, I believe it is so important that an international conference at the top, between the chiefs of states, the President of the United States with the Presidents of the other countries, and so on, meet, it would be a worthwhile thing to do, to discuss only the question of pollution, to have the same tendency everywhere.

Now, the second aspect of your question is the control of the decision, of how to do it.

Now, everything can be controlled by satellites. You have satellites that can take pictures of the oceans, and they are able to detect very, very thin layers of oil for hundreds of miles, so there are many ways of enforcing an agreement, and then it needs to be an intelligent agreement to begin with. And what to do with the boat which is known to have dumped oil into the ocean, for instance? If you would decide that any boat which was known to have dumped oil into the ocean, would be banned from the American ports, and everybody would do the same in a very, very short time, these people would stop dumping.

Again, it is a question of money. It would be expensive; but if you can save the future of mankind, the question of money is just a purely artificial question, but people have to be prepared to make personal sacrifices, and I believe it is one of your responsibilities to inform the public what this will cost, and we have no other chance, no other way to do it, and it will cost everybody, the Government and to the public.

Senator EAGLETON. Doctor, in addition to your various scientific explorations and what have you, are you involved personally in any kind of a world movement to clean up the oceans?

Dr. PICCARD. Well, I recently created a foundation for protection and study of the environment.

I have this foundation in Switzerland, and I just now am creating a sister foundation here in Washington, D.C., and the foundation will work in several ways. It will sponsor teams of scientists and researchers to study problems of pollution, and then these people will come back to the foundation, and the foundation will make remarks and recommendations to the responsible people, which could be industrialists or Government people.

Senator BOGGS. On that point, is there any group that you know of putting together a dictionary on this subject?

Dr. PICCARD. No.

Senator BOGGS. Nobody is undertaking anything like that?

Dr. PICCARD. No, and this is one of the goals of our foundation; and another goal of our foundation is the creating of an institute, and in this institute we will teach the basic laws of ecology to various levels.

The first level is the municipal level, because very often in small cities, the people are willing to do something, but they do not know what to do, they do not know how smoke is dangerous, so this would be one level.

The second level would be an industrialized level, where we would teach big people in industry; they have to know about the causes and the problems of pollution.

They are very often very willing to do something, but they do not know what, and the third level would be the postgraduate level, those with degrees, and so on.

This is what we are involved in now.

Senator EAGLETON. Doctor, have you given any thought to the problem of the general runoff from the land? That is, if we and all of the other nations of the world did a good job of controlling overt ocean dumping, how severe would our remaining problem be just from the runoff from farmland that has herbicides and pesticides, and so forth in it that the rain washes into the rivers, and into the gulfs and the oceans?

Would that still be a problem, and if it would, how should we cope with it?

Dr. PICCARD. This is one of my definitions of ocean dumping.

It can arrive in the ocean through the river, or through boats, or through the air, or the atmosphere.

For me, it is all dumping, whatever it is, and the problem is it is finally going to the bottom of the oceans, and first it has to cross the layers of phytoplankton, which are just below the surface, and a great part of the poisons are just absorbed, and this is done while the waste is going to the bottom of the sea.

So even if we admit it is not dangerous at the bottom of the sea, it may be dangerous while going down from the shore directly to the great depths.

Senator EAGLETON. Let me specifically ask this: Some of the pesticides and herbicides that farmers put on their soil can be washed off into the rivers—are pesticides and herbicides as you view it, a dangerous factor in this ocean problem?

Dr. PICCARD. Herbicides are just built to destroy plants, and phytoplankton are plants, so the phytoplankton will just be killed by these herbicides.

Senator Boggs. Mr. Chairman, may I ask the Doctor what I would consider a light question.

In view of your studies and your experience in the Gulf Stream, why are the fish sometimes there when you go fishing and some other times they have disappeared from the area? I am speaking of sports fishing.

Is it the temperature of the water?

Dr. PICCARD. The temperature of the water is a very important factor.

They found out very precisely about 15 years ago off San Diego, Calif., where up to that time the sardines were to be caught by millions, and suddenly, in 1 year, they just disappeared, and they went much farther away, and the temperature of the water just changed about 1 degree Fahrenheit. The temperature is very important.

Now, everything which is smelling in the water is very important.

Fishes are migrating, most probably, as much as we know, due to the smelling capability.

They smell the odor of the water, and they know the odor has not been the same odor that is elsewhere, and they leave one place to go to another, and the population of the fish goes down to nothing. Sometimes the pollution of the water is enough for the fish to send them to other places, so it is quite obvious if we put anything which has a bad

smell in the water, the fish will just disappear, they will go to another place.

Senator BOGGS. Thank you. It is very interesting.

Dr. PICCARD. During the drift submerged in the Gulf Stream, we have been accompanied for 36 hours by various schools of tuna fish, and they were going to Europe using the Gulf Stream, so they were just trying to save time by using the Gulf Stream, and they were crossing the Atlantic.

I don't know what they were doing with the time they saved, of course.

Senator BOGGS. The sport fish I was thinking about used to be off the shores of New Jersey, Delaware, and Maryland.

They have gone now. Commercial fishing used to be a great industry. But all of a sudden 3 or 4 years ago the fish just disappeared, and the industry had to close up.

Dr. PICCARD. In many cases we do not know if they disappear because they go some other place, or they just disappear because there are no more fish.

In many cases we fish too much, and we catch the young ones, and they just disappear.

You know, in Peru, it is one of the most important fishing countries, and they are catching every year 10 million tons, which is about 20 to 25 percent of the full fishing industry of the world, and when they started a few years ago, they were just fishing very close to the shore, on the Continental Shelf, and now they have to go miles, hundreds of miles away to find these fish, and, again, we do not know if the fish disappear close to the shore, because they moved, or because there is just no more fish, because they fished too much.

It is one of the problems we are likely to study.

Senator BOGGS. I might ask one other question.

Does the Gulf Stream follow the Continental Shelf?

Dr. PICCARD. The Gulf Stream, in some way, I would not say the Continental Shelf, but the profile from the bottom of the ocean, somewhere it is only the Continental Shelf, and it has no chance to go any other place, but after Cape Hatteras, it goes far away from Cape Hatteras, and it goes across the Atlantic, but even crossing the Atlantic, it goes sometimes moving around the sea mountains, so it tries to find the easiest way to go.

Senator BOGGS. What makes the Gulf Stream?

Dr. PICCARD. The Gulf Stream is made—first, let me say, nobody knows, but as much as we know, there are various parameters.

One thing is the trade winds, crossing the Atlantic, and pushing the water with the wind, to the Gulf of Mexico. With such a big power, it will go into the Gulf of Mexico, and it has to go out again, and the only way it can go is around Florida, and then it takes another parameter, which is different, and it goes where the waters are warmer, and they have a tendency to come up, so it gives a movement toward the north, and finally a very important parameter Coriolis effect which is a geophysical force, due to the rotation of the earth, and this combines with the local geography of the sea, and that can explain in part the making of the Gulf Stream.

Senator BOGGS. Thank you.

Senator EAGLETON. I have two more questions.

Our staff is very interested in the ocean currents, and we would like to know how carefully should we—mankind—be in preserving ocean currents as they now are. Or to put it another way, if changes in ocean currents or in ocean current patterns were made would it have an adverse effect?

Dr. PICCARD. No, please do not touch the ocean currents.

It would be terrible, because the full meteorological equilibrium of the world is dependent on the currents, so I would insist you not touch the Gulf Stream for one good reason.

The center of Europe and East Europe is affected by the Gulf Stream, and in this transmittal of calories which keeps the glaciers to the north very small, and without the Gulf Stream, the temperature will decrease a few degrees, and the glaciers will recover; they will expand, to the point that all Switzerland will be completely covered by glacier, so please do not touch the Gulf Stream.

Senator EAGLETON. I promise. [Laughter.]

Senator BOGGS. The moon causes tides. Does the moon have anything to do with currents?

Dr. PICCARD. The moon directly affects the tides and the current. I am not sure, but the tide, yes; it is caused by the moon, and partly by the sun.

Senator EAGLETON. Does the dumping of sludge cause the red tides that afflict the Atlantic coast of the United States?

Dr. PICCARD. What is called the red tide, really, is not produced so much by the dumping in the oceans.

It is just an explosion of some kind of algae, which is extremely dangerous for man.

The cause of this is occasioned by these small plants growing very, very fast, and nobody knows why, and it is obviously because some kind of equilibrium is wrong, so maybe if we interfere in the sea with dumping in the ocean, it can change this balance to the point where this red tide would come again.

They can, and it might turn out, and it did once prove to be so dangerous that it killed millions of tons of fish.

I do not believe that the red tide has any real connection with dumping, but I know, and we know the dumping may change the equilibrium in some kind of way we do not know, and whether this could help or prevent the explosion of the red tide.

Senator EAGLETON. Doctor, do you agree with the theory of Dr. Cole, which he stated apparently a few years ago, that the combination of spilled and dissipated herbicides could kill off enough phytoplankton to cause an oxygen shortage?

Are you familiar with Dr. Cole's theory, and how do you analyze it?

Dr. PICCARD. Yes; as I pointed out, about two-thirds of the oxygen of the atmosphere is coming from the sea.

The rest is coming from the plants, forests, meadows, and so on, so this is absolutely correct, there is no doubt if we destroy the phytoplankton of the sea, we will suffocate by a lack of oxygen.

There is no doubt about this. The question is to know if the waste from the industry is able to finally destroy the phytoplankton.

It is a question, not of quality, but of quantity, and this has not been computed, but, as I mentioned, there are scientists who believe this may come within 30 to 50 years.

Senator EAGLETON. Are you familiar with a study by the Franklin Institute, a study of proposed outfall pipe from the Delaware River Basin, to the edge of the Continental Shelf?

Dr. PICCARD. Unfortunately, I am not aware of the final decision, but I am familiar with some of the studies.

The Franklin Institute used the submersible *Ben Franklin*, and we used that submarine for ocean survey with the Ben Franklin Institute scientists, just to study this area, where they expected to have the pipeline for dumping, and at that place, there are a lot of currents, so the water is not stagnant, which some people consider is good, because we just throw away the material, and then some people say wait, we do not know where this matter is going.

Is it a small branch of the Gulf Stream, and where does the matter go, and where will it lead, so in this case, a submarine is a good tool for studying the deep oceans.

We can take the best scientists down and study the problem, but as much as I know, they did not decide anything as of now, but they have at least a better knowledge than when we started.

Senator EAGLETON. Well, Doctor, I have several other questions, but you have been very indulgent and very patient with us here today.

We do not want to burden you any further, but I would like to ask Senator Boggs if he has any further questions.

Senator BOGGS. I have no further questions. I do want to thank the good Doctor very much for his contribution to the subcommittee.

He has been very informative, and I am certain this information will be of tremendous help to the subcommittee.

Again, I thank you very much, Dr. Piccard.

Senator EAGLETON. It has been a very interesting morning, and very informative.

We are grateful to you for making yourself available for this presentation, and you have made a wonderful contribution, both in the past, and I am sure you will continue to do so in the future.

Senator BOGGS. Thank you very much, Doctor.

(Whereupon, the hearing was adjourned at 11:30 a.m., subject to the call of the Chair.)

(Appendix to this day's proceeding follows:)

APPENDIX—JUNE 16, 1971

The following paper was received subsequent to the hearings and submitted for inclusion in the record by Chairman Muskie.

EVALUATING WASTE DISPOSAL AT SEA—THE CRITICAL ROLE OF INFORMATION MANAGEMENT¹

By ROBERT P. BROWN² and EDWARD H. SHENTON³

ABSTRACT

An evaluation is presented of a 1971 re-survey of present and projected U.S. ocean dumping activities in terms of proposed Congressional legislation. A drastic reduction in ocean dumping volume has occurred along the Pacific Coast. Anticipated termination of the dumping of toxic materials and other wastes will significantly change the national status of dumping activities. The results of the study show that although adequate information on the subject is available, the latest projections for funding future regulatory surveillance and environmental monitoring of dumping operations are based on 1968 data which do not describe the current situation.

The foregoing situation reflects the present lack of an effective ocean dumping information system. Potential values to be derived from an improved system are described and the status of ocean dumping for 1972 is projected.

PURPOSE

The purpose of this report is to describe the urgent need for accurate, current information on ocean dumping operations to assist persons in government responsible for making decision. Examples are presented which demonstrate the inadequacies of the present system and the potential values to be derived from an improved system.

BACKGROUND

An appraisal of the national status of ocean dumping of solid and liquid wastes was conducted for the U.S. Bureau of Solid Waste Management (BSWM) of the Environmental Protection Agency (EPA) in 1969 (Smith and Brown, in press). The results of this study showed that an estimated 48 million tons of dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid waste, explosives, chemical munitions, radioactive wastes, and other miscellaneous wastes were dumped via barges and ships into coastal waters during the calendar year of 1968. These wastes originated from twenty U.S. cities including: Seattle, Portland (Oregon), San Francisco, Los Angeles, San Diego, Galveston, Texas City, Houston, Port Arthur, Beaumont, New Orleans, Pascagoula, Mobile, St. Petersburg, Charleston, Norfolk, Baltimore, Philadelphia, New York, and Boston.

CURRENT NATIONAL POLICY

Significant changes in national policy affecting ocean dumping operations have taken place since the BSWM study was concluded in 1969. The catalyst for these changes was the publication by the President's Council on Environmental Quality report entitled *Ocean Dumping—A National Policy* (1970). Recommendations for banning or curbing future ocean dumping activities contained

¹ This paper is based partially on work conducted under Contract PH 86-68-203 for the Bureau of Solid Waste Management, Environmental Protection Agency.

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in this report were strongly endorsed by President Nixon and subsequently have formed the basis for the proposed Marine Protection Act of 1971. Both Administration and Congressional leaders are in accord for the need for strong ocean dumping legislations. Hearings being conducted at the time of this writing in both the Senate and House have focused on the details of which types of wastes will be banned or phased out, permit granting procedures, surveillance, and research requirements for assessing the environmental effects of ocean dumping. Regardless of the details, passage of some form of Marine Protection Act seems a certainty before Congress convenes in 1972.

NEED FOR IMPROVED INFORMATION MANAGEMENT

From the results of the BSWM study it is apparent that regardless of the type of legislation that is enacted by Congress, proper record preparation and maintenance by the agencies responsible for regulating ocean dumping is an essential first step in enforcement and environmental monitoring of the operations. Equally important is a formalized reporting system which results in the preparation of regional and national summaries on an annual basis. In addition to the basic data on dumping operations, information available from each region regarding legal aspects, research performed or in progress, and information on specific procedures established for regulating and enforcing dumping operations should also be included in any proposed information system.

STATUS OF THE NATIONAL OCEAN DUMPING INVENTORY

Current legislative action and governmental agency planning activities regarding ocean disposal are based on the BSWM study results presented in the President's Council on Environmental Quality report (1970). As nearly as can be determined, the status of ocean dumping has been assumed to be either static at the 1968 figure of 48 million tons, or increasing at some unknown rate. This is the direct result of the lack of an annual inventory of ocean dumping activities.

RE-SURVEY OF PACIFIC COAST DUMPING OPERATIONS—1971

To assess the accuracy of these assumptions the author has re-surveyed the status of ocean dumping for the Pacific Coast on the basis of his original BSWM study contacts. Dredging spoils, explosives, and radioactive wastes have been excluded from this 1971 inventory because of the limited time available. The results of this survey are shown in Table 1 along with the reported 1968 BSWM dumping totals.

From Table 1 it can be seen that ocean dumping (excluding dredging spoils) for the Pacific Coast has decreased from a reported 1,007,500 tons in 1968 to 23,860 tons in 1971, or approximately a reduction by 50 times. The major factors associated with this dramatic decrease are (1) the banning of ocean dumping by the Regional Water Quality Control Boards (RWQCB) in the cities of San Francisco and San Diego, and (2) the "voluntary" cessation of several large-volume dumping operations such as filter cake in San Diego, oil drilling wastes from Los Angeles, and paper mill wastes and waste oil from Seattle.

In addition to disclosing a marked decline in ocean dumping activities off the Pacific Coast, the present study confirmed previously unsubstantiated reports (American Petroleum Institute, 1969) regarding the disposal of refinery wastes by crude oil tankers beyond 50 miles from the California Coast. Operations of this nature in San Francisco are under a RWQCB "cease and desist" order to terminate activity by the end of 1971. Based on knowledge regarding ocean dumping of refinery wastes gained during the 1969 BSWM survey, it is clear that the extent of this practice should be investigated and documented on a national basis.

INFORMATION EXCHANGE

During the BSWM study it was found that although many governmental agencies were involved in one way or another in ocean dumping activities in a particular city, rarely did more than one of these have a comprehensive picture of the total dumping activities in their city. The present re-survey of the West Coast dumping operations revealed that this picture has improved slightly on the local level, primarily because of the publicity given the subject over the past year. However, with respect to knowledge and exchange of information of ocean dumping operations on a regional basis (i.e., state, coast), the 1969 picture is unchanged. The ramifications of this are discussed later in this report.

PROJECTED STATUS OF OCEAN DUMPING--1972

Based on the findings of the BSWM study and the Council on Environmental Quality's report it is no exaggeration to state that the environmental effects of past and present dumping operations are, with the exception of those dumped in the New York Bight (sewage sludge, waste acid, dredge spoils) and off Cape May, Delaware (waste acid, sewage sludge) not even qualitatively known, much less measured accurately. It is obvious that if ocean dumping of wastes were to continue at the 1968 level without causing harmful effects to man or the environment, a major research effort in this area would be essential. A similar conclusion can be drawn in terms of the need for improved regulatory and surveillance procedures.

STUDY ASSUMPTIONS

However, before research money is appropriated and spent, it is advisable to carefully examine all of the information (including various recommendations made by numerous individuals and agencies) available to date on ocean dumping. As in most cases, assumptions must be made. For the purpose of this paper the recommendations of the President's Council on Environmental Quality, which have been endorsed by the President and the Environmental Protection Agency (Air/Water, 1971), provide the basic guidelines for the following assumptions:

General ocean dumping of industrial wastes will be phased out as soon as possible.

Ocean dumping of toxic industrial wastes will be terminated immediately, except in those cases in which no alternative offers less harm to man or the environment.

Continued dumping of digested/undigested sewage sludge is considered an interim measure and will be phased out as soon as possible and no new sources allowed.

Ocean dumping of polluted dredge spoils and solid wastes will be phased out as soon as possible.

Ocean dumping of radioactive, explosive, and chemical warfare agents will be banned.

With the foregoing guidelines it is appropriate here to examine the projected national status of ocean dumping with respect to the major areas requiring expenditures for future regulatory monitoring and environmental research. The first question that arises is how much, how many, and what kind of ocean dumping activities will be in operation if the foregoing recommendations become law?

PACIFIC COAST

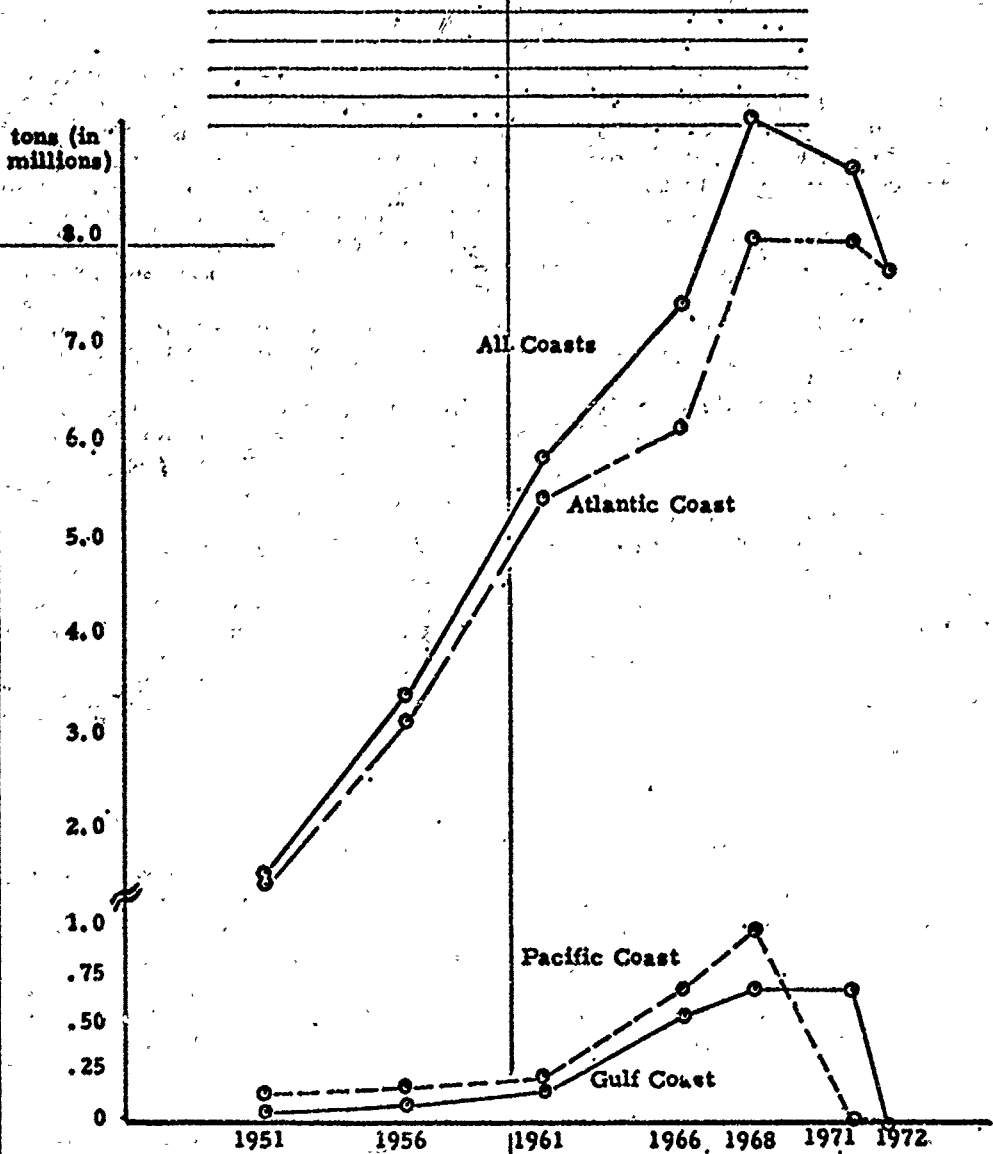
Let's consider the Pacific Coast first. From Table 1 it can be seen that at the close of 1971 only four (4) of the original thirteen (13) 1968 dumping activities are currently in operation, namely, cannery wastes (San Francisco), toxic industrial chemicals (Los Angeles), and commercial vessel refuse and garbage (Los Angeles). The latter two activities fall within the categories subject to near-term phase-out. Thus, it is anticipated that within a short period of time (ca. 1972) the only Pacific Coast dumping operation (excluding dredge spoils) with any possibility of being continued consists of about 20,000 tons of cannery wastes which are dumped at sea on a seasonal basis (June-October).

ATLANTIC AND GULF COASTS

A breakdown by waste category (excluding dredge spoils) for the Gulf and Atlantic coastal areas is presented in Table 2. These wastes have been categorized in terms of the guidelines presented previously (i.e., industrial, sewage, etc.). From Table 2 it is clear that, on the basis of the study assumptions, of the thirty-eight (38) known individual disposal operations represented by the summary figures, only six (6) would be in existence in the near future. These include sewage dumping (New York, Philadelphia), waste titanium processing acid (New York and Delaware), and construction and demolition debris (New York). Based on the results of past environmental research, only the dumping of waste acid and construction debris have a chance of continuing on a regular long-term basis.

Figure 1., Average Annual Tonnage Dumped at Sea --
by Coastal Area

Source: Council on Environmental Quality, 1970 (a)



(a). See text for explanation of 1971-72 tonnage projections.

TABLE 1.—SUMMARY OF THE TYPE, AMOUNT AND NUMBER OF INDIVIDUAL OCEAN DUMPING OPERATIONS FOR THE PACIFIC COAST, 1968 AND 1971

Type of waste	1968 ¹ annual tonnage	Number of ² individual dumping operations 1968	1971 annual tonnage	Number of individual dumping operations 1971
Industrial: ³				
Spent steel pickling acid (sulfuric and hydrochloric).....	41,700	1	-----	Discontinued February 1971.
Refinery wastes.....	164,160	2	2,160	To be discontinued December 1971.
Toxic chemicals ⁴	506	3	500	2.
Paper mill wastes.....	116,534	1	-----	Discontinued 1970.
Oil drilling muds.....	653,100	1	-----	Discontinued December 1970.
Waste oil.....	5,300	1	-----	Discontinued 1970.
Cannery wastes.....	20,000	1	20,000	1.
Vessel refuse and garbage.....	6,200	3	1,200	1. ⁵
Filter cake.....	-----	-----	-----	Discontinued 1970. ⁶
Total all wastes.....	1,007,500	13	23,860	4.

¹ Based on 1968 BSWM data (Smith & Brown, in press) excluding dredge spoils, explosives and radioactive wastes.

² Based on private survey conducted in May 1971.

³ Includes bulk and containerized wastes.

⁴ Includes cadmium, copper and chromium cyanide, laboratory wastes, and other unidentified industrial wastes.

⁵ U.S. Naval dumping operations were discontinued in 1968 and 1970 for San Diego and Long Beach, respectively.

⁶ 346,480 tons of filter cake were dumped in 1969-70.

TABLE 2.—SUMMARY OF THE TYPE, AMOUNT AND NUMBER OF INDIVIDUAL OCEAN DUMPING OPERATIONS FOR THE ATLANTIC AND GULF COASTS, 1968¹

Type of waste	Atlantic coast		Gulf coast		Total	
	1968 ¹ annual tonnage	Number of individual dumping operations	1968 ¹ annual tonnage	Number of individual dumping operations	Annual tonnage	Number of individual dumping operations
Industrial: ²						
Spent acid wastes (sulfuric and hydrochloric).....	2,673,790	3	5,000	1	2,678,790	4
Refinery wastes.....	124,850	2	273,850	5	398,700	7
Pesticide wastes.....	67,120	4	261,215	9	328,335	13
Paper mill wastes.....	-----	-----	35,000	1	35,000	1
Others ³	163,237	3	116,170	7	279,407	10
Municipal:						
Sewage sludge.....	4,477,000	4 ²	-----	-----	4,477,000	2
Construction and demolition debris.....	574,000	1 ⁴	-----	-----	574,000	1
Total, all wastes.....	8,079,997	15	691,235	23	8,771,232	38

¹ Based on 1968 BSWM data (Smith & Brown, in press), excluding dredge spoils, explosives and radioactive wastes.

² Includes bulk and containerized wastes.

³ Includes noxious chemicals, sodium and cyanide sludge, ammonium sulfate, mother liquor, and tetraethyl lead sludge tanks.

⁴ Several different municipalities dump sewage sludge in the two (2) designated New York and Delaware sewage dump sites.

⁵ Numerous independent contractors utilize the one (1) designated New York dump site.

TOTAL U.S. OCEAN DUMPING

In terms of total U.S. dumping tonnage (excluding dredge spoils, explosives, and radioactive wastes), the foregoing would result in a reduction from about 10 million tons in 1968 to 8 million tons in 1972. The number of individual dumping operations would be correspondingly reduced from the 1968 figure of 52 for all coasts to a total of seven (7) in 1972. It is significant to note that six (6) of these remaining dumping operations would be restricted to the Atlantic Coast, particularly the New York Bight area.

Figure 1 shows the long-term U.S. ocean dumping trends presented in earlier reports on the subject (Smith & Brown, in press; Council on Environmental Quality, 1970) and the results of the present study. The 1971 tonnage figures shown in Figure 1 are based on the detailed re-survey of Pacific Coast dumping operations conducted by the author. For the lack of up-to-date data, it has been assumed that the Atlantic and Gulf Coast dumping operations have remained static. Projected values for 1972 are based on the analysis presented in this paper.

From the data shown in Figure 1 and Tables 1 and 2 it should be apparent that future appropriations of funds designated for new research and improved regulation and surveillance procedures of ocean dumping must be carefully weighted in terms of the actual scope and number of dumping operations involved. To allocate funds solely on the basis of the 1968 BSWM survey data would clearly be in error.

EVALUATION OF PROPOSED FY 1972 FUNDING FOR REGULATORY AND ENVIRONMENTAL MONITORING

To this point this paper has been concerned primarily with documenting the inadequacies of the present practices of maintaining accurate, current information on ocean dumping activities for the purpose of detecting trends in U.S. coastal waters. The discussion presented in this section will assess future requirements for funding of ocean dumping research and surveillance based on the observed and projected trends.

PROPOSED FUNDING

The Environmental Protection Agency has stated that it expects to spend \$2 million in fiscal 1972 on ocean dumping matters if the Administration bill to control marine disposal is enacted this year (Oceanology Weekly, April 30, 1971). About \$1.5 million of this is designated for research and development and the remainder is for setting standards and enforcing them. Similarly, the U.S. Coast Guard estimates that about \$1.3 million should be added to its budget next year if the dumping bill is passed (Oceanology Weekly, April 23, 1971). This amount would be for surface and aircraft surveillance of dumping operations. Thus, the combined funding proposed for FY 1972 for regulatory and environmental monitoring of ocean dumping would be approximately \$3.3 million *based solely on the 1968 BSWM assessment of the dumping situation.*

REGULATORY MONITORING REQUIREMENTS

If the status of ocean dumping is viewed in terms of the projections presented in this paper only six (6) individual dumping operations off the Atlantic Coast and one (1) off the Pacific Coast would require routine regulatory monitoring in 1972. At the present time the dumping of sewage sludge, waste acid, and construction debris in the New York Bight is under rigid control by the U.S. Corps of Engineers. The disposal of cannery wastes at sea off San Francisco is under similar strict control by the San Francisco State Regional Water Quality Control Board.

Buelow (1968) has reported that the size of the present dumping ground for sewage sludge off Cape May, New Jersey is incompatible with the present methods of discharge. Under the present system, a barge operator must either discharge his load within 10 minutes at full speed, or reverse course and make another run through the dumping ground. In one dumping operation observed by Buelow, approximately two-thirds of the load was dumped outside of the designated area. Unless the regulatory situation has changed since 1969 no routine on-site inspection of dumping operations is conducted by any regulatory agency of the sewage and acid dumping operations.

If the foregoing situation regarding proposed funding and projected disposal operations proves to be correct, then, as proposed presently, \$1.8 million will be available in FY 1972 for the enforcement of seven (7) dumping operations, four of which are apparently under adequate regulatory control.

ENVIRONMENTAL RESEARCH REQUIREMENTS

As mentioned earlier, \$1.5 million is proposed by EPA for research and development on ocean dumping for FY 1972. A considerable amount of research has already been done on the dumping of sewage sludge and waste acid at sea.

Sewage sludge

Conclusive evidence has been presented by Buelow (1968), Buelow et al (1968^a), the Sandy Hook Sport Fisheries Marine Laboratory (1970), and Ketchum (1970), that present practices of sewage sludge disposal off New York Harbor have destroyed the quality of the environment over a substantial area of sea bottom and caused contamination of valuable living marine resources adjacent to the dumping grounds. Similar evidence has been presented by Buelow et al (1968^b) for the sewage dumping grounds 12 miles off Cape May, New Jersey; however, this point has been contested by others (Air/Water News, April 5, 1971). Because of the large-scale nature of the sewage dumping operations and lack of better alternative methods, no near-term banning of these operations can be expected. Future work in these areas should be directed towards minimizing future environmental damage by continued monitoring of the dumping grounds coupled with better treatment of the sewage sludge prior to disposal (Council on Environmental Quality, 1970).

Acid-iron wastes

Studies of the dispersion and environmental effects of acid-iron wastes dumped in the New York Bight area have been conducted by Redfield and Walford (1951), Ketchum and Ford (1952), Ketchum et al (1958), and most recently by the Sandy Hook Sport Fisheries Marine Laboratory in Sandy Hook, New Jersey (1970). The disposal of similar wastes occurs about 45 miles southeast of the mouth of Delaware Bay and has been investigated by the Dupont Corporation in cooperation with EPA (Fader, 1970). To date, the sum of the results of these investigations show that the toxic effects of acid-iron wastes disposed of at sea are apparently minimal (Dr. Jack Pearce, Sandy Hook Sport Fisheries Marine Laboratory, personal communication). Future work on the acid dumping ground is open to questions, however, the establishment of a routine environmental monitoring network for this area is desirable.

Construction and demolition debris

The environmental effects of the dumping of construction and demolition debris at sea has not been investigated in the New York Bight Area. However, recent studies conducted by the Sandy Hook Sport Fisheries Marine Laboratory (1970) and related studies by the California Department of Fish and Game (1969) have shown that properly constructed artificial fishing reefs are a very effective means in congregating the available fish from a given area. With both the great increases in the numbers of sportfishermen each year (Winslow and Bigler, 1969) and when most of the Continental shelf within their reach from small craft is an unproductive, flat, lifeless, sandy desert, the utilization of "clean" solid waste material for the purpose of developing artificial fishing reef offers a huge potential for deriving real benefits. Commercial fishing operations in the coastal zone might also benefit from such a program. It has been postulated that artificial reefs constructed from solid waste materials could serve to increase the populations of migratory fish by providing additional spawning sites for adults and protection and food for the juveniles (U.S. Bureau of Sport Fisheries and Wildlife, 1968). Although it has proven possible to construct artificial fishing reefs from certain classes of solid wastes (i.e., tires, cars, rubble, etc.), present practice favors disposal in landfills or recycling as scrap steel. Clearly, there is an immediate and continuing need for research and development in this area.

Cannery wastes

The Pacific Coast cannery waste dumping operation (San Francisco) is currently the subject of a research investigation by the National Cannery Association, Berkeley, California (National Cannery Association, 1971, personal communication). This is to be a three-phase study to determine (a) the detailed characteristics of the wastes, (b) their toxicity, and (c) the mixing and dispersion of the wastes at sea.

Other wastes

It has been proposed by various individuals testifying before House and Senate committees concerned with proposed dumping legislation that dumping of "compatible" wastes in the ocean is "highly desirable" (Oceanology Weekly,

April 23, 1971). Examples of compatible wastes were construction and demolition debris, various agriculture and cannery wastes, oil well drill cuttings, effluent (but not sludge) from sewage treatment plants, materials hazardous to man such as obsolete, non-chemical munitions, and municipal refuse and garbage. Various aspects of the first two classes of waste have been discussed in this paper.

Oil Drilling Wastes. The disposal of oil well drill cuttings and mud in 1968 consisted of a single operation on the Pacific Coast (Table 1). This operation was voluntarily terminated in 1970. Detailed information from an independent investigation of this operator was obtained from the files of the Los Angeles Regional Water Quality Control Board (LARWQCB, 1971). Based on the operator's logs of travel time to and from the dump site, there were ninety-eight (98) specific violations noted when the operator could not possibly have been in the official dumping ground. Additionally, these logs showed instances when considerable amounts of oil were noted in the wastes dumped which was in direct violation of the dumping permit. In view of the foregoing and the fact that the dumping of oil drilling wastes was a "special" type of operation and alternate disposal methods are available, the authors believe that no further research or initiation of new dumping operations should be considered for this category.

Sewage Effluent. The disposal of sewage effluent at sea is currently a common practice using submarine outfalls. There have been suggestions of barging this sewage farther offshore. One has only to consider the volume of these wastes generated daily to realize that a barging operation is out of the question. For example, the combined discharge from the Los Angeles Area outfalls is close to one (1) billion gallons per day or about 1,000 barge (1×10^6 -gallon capacity) loads.

Explosives and Radioactive Wastes. Both the Department of Defense (San Diego Union, February 25, 1971) and Atomic Energy Commission (Oceanology Weekly, April 9, 1971) have announced the banning of ocean dumping of obsolete gas, explosives, and radioactive wastes. Secretary of the Navy John H. Chafee has directed that an intensive program of research and development be conducted to seek alternative disposal methods. Low-level radioactives formerly dumped at sea will be land-buried, and high-level wastes will be sealed in salt mines and solidified.

Municipal Refuse. Another item on the list of "compatible" wastes proposed for future sea disposal is organic municipal refuse. Several schemes have been proposed for this including at-sea incineration, baling, and other containerized methods (Silverman, 1964; Dulea, 1967; Balbi, 1968; Smith, 1968; and National Industrial Pollution Control Council, 1971). The most recent of these by the National Industrialized Pollution Control Council recommends conducting a research investigation of baled refuse in 7,500 feet of water just beyond the edge of the New England Continental Shelf. The utilization of deep-ocean trenches for waste disposal has also been proposed (Bronson and Sherif, 1970). The closest such deep trench to the West Coast cities is off the Aleutian Islands. East Coast and Gulf Coast cities would be required to transport their wastes to the Caribbean area for disposal. The authors favor none of these methods, but concur regarding this matter with the recommendations of the Council on Environmental Quality (1970, p. vi):

"Ocean dumping of existing sources of solid wastes should be stopped as soon as possible. No new sources should be allowed, i.e., no dumping by any municipality that currently does not do so, nor any increase in the volume by existing municipalities."

From the foregoing evaluation of past research conducted in connection with the ocean dumping activities projected to be in operation in 1972, the most promising areas for expenditures of proposed research funds appear to be in the enhancement of the marine environment (reef building) and establishing adequate environmental monitoring systems. With regard to the latter there is an urgent need for the establishment and monitoring of marine research preserves to serve as baselines from which man-made changes of the environment can be evaluated (Commission on Marine Science, Engineering and Resources, 1969; Council on Environmental Quality, 1970).

CONCLUSIONS

A drastic reduction in ocean dumping volume occurred on the Pacific Coast in 1971. Anticipated termination of the dumping of toxic material and other wastes will significantly change the national status of ocean dumping activities in 1972.

Current Governmental projections for funding future regulatory surveillance and environmental monitoring programs for ocean dumping activities are based on 1968 BSWM data and do not reflect the current situation.

There is an urgent need for the establishment of an effective ocean dumping information system to assist Governmental decision makers in correctly assessing trends, research needs, and current activities associated with ocean dumping.

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